SYSTRON DONNER
A THORN EMI company

MODEL 410 PULSE GENERATOR

SYSTRON DONNER
Member THORN EMI Group

MODEL 410 PULSE GENERATOR

INSTRUMENT DIVISION

OPERATING AND SERVICE MANUAL

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SYSTRON DONNER CORPORATION

ADDENDUM

MODEL 410 US Army P/N 11513207

U. S. Army Part Number 11513207, Generator Sweep, is a standard Systron Donner Model 410 Sweep/Function Generator as described in this manual and Specification Control Drawing #11513207.

List of Repair Parts for Generator Sweep U.S. Army Part No. 115131207 is as follows:

LIST OF REPAIR PARTS

Ref Sym	IDENTIFICATION	NOMENCLATURE	MANUFACTURER's ITEM IDENT NO	REQ/ UNIT	GOVT AGENCY IDENT PART NO.
F1	15470-037	Fuse, Slo-Blo	MDL-2	1	11513207-2
	17130-000	Line Cord, Pwr	17130-006	1	11513207-3
	C24010-031	Transformer		1	11513207-4
	15400-037	Knob	700C-2	7	11513207-5
	15400-034	Knob	P570D-2	2	11513207-6
	15400-034	Knob	P550D-2	7	11513207-7

MODEL 410
GENERATOR SWEEP
U.S. Army
P/N 11513207

TEST & MEASUREMENT GROUP
OF
SYSTRON DONNER
WARRANTY POLICY

I – Warranty

The Test & Measurement Group of Systron Donner warrants that at the time of shipment the products manufactured by Systron Donner's T&M Group and sold hereunder will be free from defects in material and workmanship and will conform to the specifications furnished by or approved in writing by Systron Donner's T&M Group.

II – Warranty

A – The warranty period for products published in our latest product catalog will be one year from the date of shipment. This warranty is extended only to the original buyer.

B – The warranty period for products published in prior catalog, will be 90 days from the date of shipment.

C – The warranty period for modified standard products, custom products, or new spare part assemblies will be 90 days from the date of shipment.

D – The warranty period for systems or assemblies of miscellaneous components and products will be limited to the warranty for the stand alone component or instrument. The system itself is not guaranteed unless a specific installation and service agreement has been negotiated between Systron Donner and the customer. In this latter case, the warranty period will be 30 days after the installation of the system while the various portions of the system will be limited to the normal component or instrument stand alone warranty, and for non Systron Donner material within the system that is furnished by Systron Donner the warranty will be limited to the suppliers normal warranty.

III – Warranty Adjustments

A – If any defect within this warranty appears, Purchaser shall notify Seller immediately.

B – Systron Donner's T&M Group agrees to repair or furnish a replacement for, but not install, any product which, within the standard warranty shall, upon test and examination by Systron Donner's T&M Group, prove defective within the above warranty period.

C – No product will be accepted for return or replacement without the written authorization of Systron Donner's T&M Group. Upon such authorization and in accordance with instructions by Systron Donner's T&M Group, the product will be returned to the original manufacturing location, shipping charges prepaid by Purchaser.

IV – Exclusions from Warranty

A – The foregoing warranty is in lieu of and excludes all other expressed or implied warranties of merchantability or fitness or otherwise.

B – Systron Donner's T&M Group will not be liable for any special or consequential damages or for loss, damages or expense directly or indirectly arising from the use of the products, or any inability to use them either separately or in combination with any other equipment or material, or from any other cause.

C – The warranty does not extend to any product manufactured by Systron Donner's T&M Group which has been subjected to misuse, neglect, accident, improper installation or to use in violation of instructions furnished by Systron Donner's T&M Group.

D – The warranty does not extend to or apply to any unit which has been repaired or altered at any place other than at a Systron Donner T&M Group factory, by persons not expressly approved by Systron Donner's T&M Group, not to any unit, the serial number of which has been removed or defaced or changed.

E – This warranty applies to new equipment only and will cover repaired or replacement items only to the extent of the balance remaining of the items original warranty period noted above in Paragraph II.

F – All freight charges will be paid for by the Purchaser.

Divisions in the Test & Measurement Group include:

Instrument Division – Concord, CA
WM Division – Sacramento, CA
ACD Division – Sunnyvale, CA
SD GmbH – Munich, West Germany

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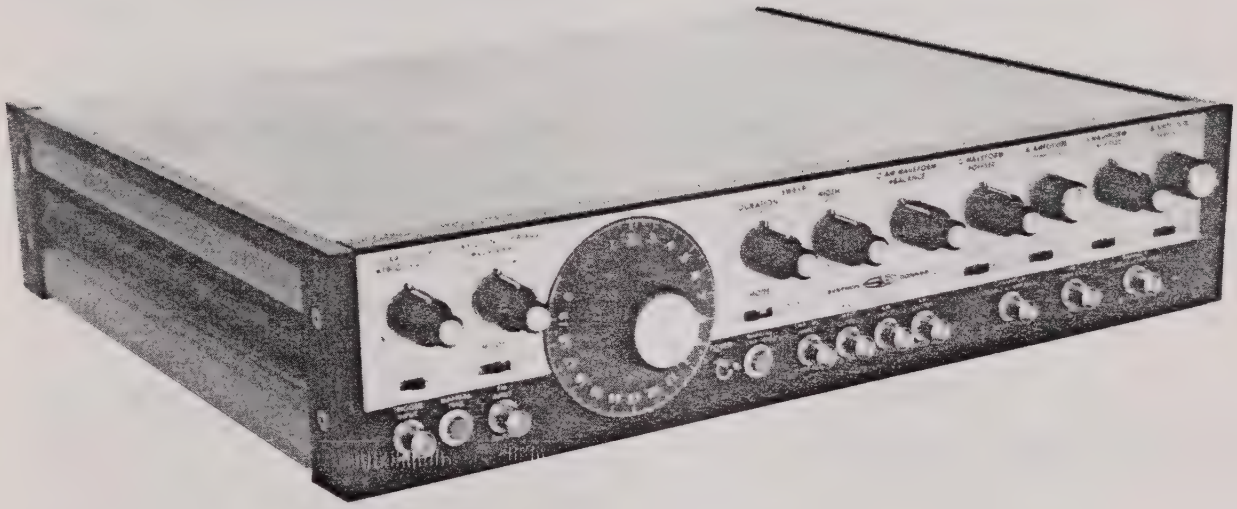


MODEL 410 SWEEP/FUNCTION GENERATOR

The Model 410 Sweep/Function generator is a highly versatile and reliable laboratory instrument capable of generating sine, square, triangle, ramp, sine squared and pulse outputs over a frequency range of from 0.0002 Hz to 2 MHz. This instrument features dual channel outputs, each having independently controllable amplitude, offset, impedance and attenuation. The output voltage is 40 volts peak-to-peak maximum, open circuit, with a dynamic amplitude range of 80 dB (2 mV p—p to 20 V p—p into 50 ohms). Sine distortion is less than 0.25% through the audio range and less than 0.5% up to 200 kHz. In the sweep mode the sweep generator sweeps from 1 to 100% of the main generator dial at rates of from 10 μs to 100 s. The sweep and main generators can be gated or triggered by an external source or the instrument can be configured so that the sweep generator functions as a trigger or gate source for the main generator. An FM input is provided for externally controlling the frequency and an AM input provides for the amplitude modulation of the side, square, triangle and ramp waveforms. A 1 volt peak-to-peak output is provided for synchronization and calibration.

SECTION I

SPECIFICATIONS

FUNCTION

Waveforms: sine, square, triangle, ramp, pulse and sine squared.

PERFORMANCE CHARACTERISTICS

Frequency Range: 0.0002 Hz to 2 MHz in 9 ranges.

Dial Accuracy: 2 Hz to 200 kHz ≤1% of setting, 0.2 Hz to 2 MHz ≤2% of setting, 0.002 Hz to 0.2 Hz ≤2% of full scale.

Frequency Vernier: approximately 1% of full scale (2 minor dial divisions).

Time Symmetry (all waveforms): >99.5%, 2 Hz to 200 kHz. >99%, 0.002 Hz to 2 Hz. >98%, 200 kHz to 2 MHz.

Frequency Stability: < ±0.05% for 1 hour. < ±0.5% for 1 month.

Temperature Stability: The frequency will not drift more than 0.05% per degree centigrade.

Sine Distortion: <0.25%, 2 Hz to 20 kHz, <0.5% 0.002 Hz to 200 kHz. <3%, 200 kHz to 2 MHz.

Sine Frequency Response: reference 1 kHz at maximum amplitude into 50 ohms. <±1% to 200 kHz. <±3% to 2 MHz.

Square Wave Rise/Fall Time: < 50 ns.

Square Wave Aberrations: <±5%.

Trigger Input: >1 V peak-to-peak.

OUTPUT CHARACTERISTICS

Amplitude: >40 V peak-to-peak maximum, open circuit.

Amplitude Range: 80 dB (2 mV peak-to-peak to 20 V peak-to-peak into 50 ohms).

Stability (amplitude): <0.1% for 1 hour.

Power: >2 W maximum into 50 ohms (square wave).

Impedance: >50 or 600 ohms, selectable by front panel switch.

DC Offset: ±20 V, open circuit. ±10 V terminated. (Combination of output amplitude and offset not to exceed ±20 V open circuit, or ±10 V terminated).

Sync Amplitude: 1 V peak-to-peak ±1%.

MODES OF OPERATION

Normal, Triggered, Gated, Sweep and Internal Trigger Gate.

MODULATION

Frequency: DC coupled. Approximately 25 mV input for 1 minor division dial deviation (4.5 V for 0.2 to 2 dial deviation). Range is >1000:1. Input impedance is 10 k ohms.

Amplitude: DC coupled. +5 V peak-to-peak input for 40 V peak-to-peak maximum at either output amplifier. Waveform to be modulated is selectable. Input impedance is 10 k ohms.

SWEEP GENERATOR

Duration: 10 μs to 100 s in 7 ranges.

Width: 0 to 100% of main generator frequency dial in 3 ranges.

Sweep Ratio: >1000:1.

Output: 5 V peak-to-peak, fixed amplitude. Output impedance is 50 ohms.

Modes of Operation: normal, triggered, internal trigger gated.

GENERAL INFORMATION

Power Required: approximately 50 W, 50–60 Hz at 105–125/210–250 V ac selectable by means of a multitap transformer and a range switch on the back panel. Fuse ratings are: 105–125 V, 1 ampere slo-blo; 210–250 V, 0.75 ampere slo-blo.

Operating Temperature: 0 to 50° C. All specifications guaranteed over an ambient temperature range of 18° to 28° C, after ½ hour warm-up.

Weight: approximately 17.5 pounds.

Shipping Weight: approximately 22 pounds.

Dimensions: 16¾" W x 3½" H x 14-5/8" D (cabinet less knob projections 13-1/8" D).

SECTION II

CONTROLS AND CONNECTORS

This section lists the front panel controls and describes their function (see Figure 2 - 1).

2.1 POWER Switch

Applies ac voltage to the primary of the power transformer.

2.2 START/STOP Control

Determines the amplitude point on the output waveform where triggering will start and stop.

2.3 TRIGGER LEVEL Control

Selects the amplitude point on the trigger signal where triggering will occur.

2.4 TRIGGER POLARITY Switch

Determines whether triggering occurs on the negative-going or positive-going edge of the trigger signal.

2.5 MODE Switch (Main Generator)

Selects one of three possible modes of operation. In the NORM position, the output is continuous. In the TRIG position, one cycle of the output waveform occurs for each trigger signal applied, provided the trigger repetition rate does not exceed the frequency setting of the main generator. In the GATE position, the output waveform occurs for the duration of the gate signal.

2.6 FREQUENCY RANGE Switch

Selects one of nine overlapping decade frequency ranges.

2.7 VERNIER Control

Makes fine frequency adjustments (approximately 1% frequency dial range — 2 minor divisions).

When the vernier control is in the CAL position, the output frequency is equal to the product of the frequency dial and range switch setting.

2.8 Frequency Dial

Continuously varies the frequency within the range selected by the FREQUENCY RANGE switch.

2.9 SWEEP DURATION Switch

Enables the sweep generator and selects one of seven available sweep rate ranges. In the OFF position the sweep generator is disabled.

2.10 Sweep Duration Vernier

Continuously varies the sweep rate within the range selected by the sweep duration switch.

2.11 SWEEP WIDTH Switch

Determines the percentage of the main generator frequency range to be swept from the dial setting by the sweep generator. In the OFF position the sweep generator continues to operate but is disconnected from the main generator input.

2.12 Sweep Width Vernier

Continuously varies the sweep width within the percentage of the range selected by the SWEEP WIDTH switch (counterclockwise for minimum width).

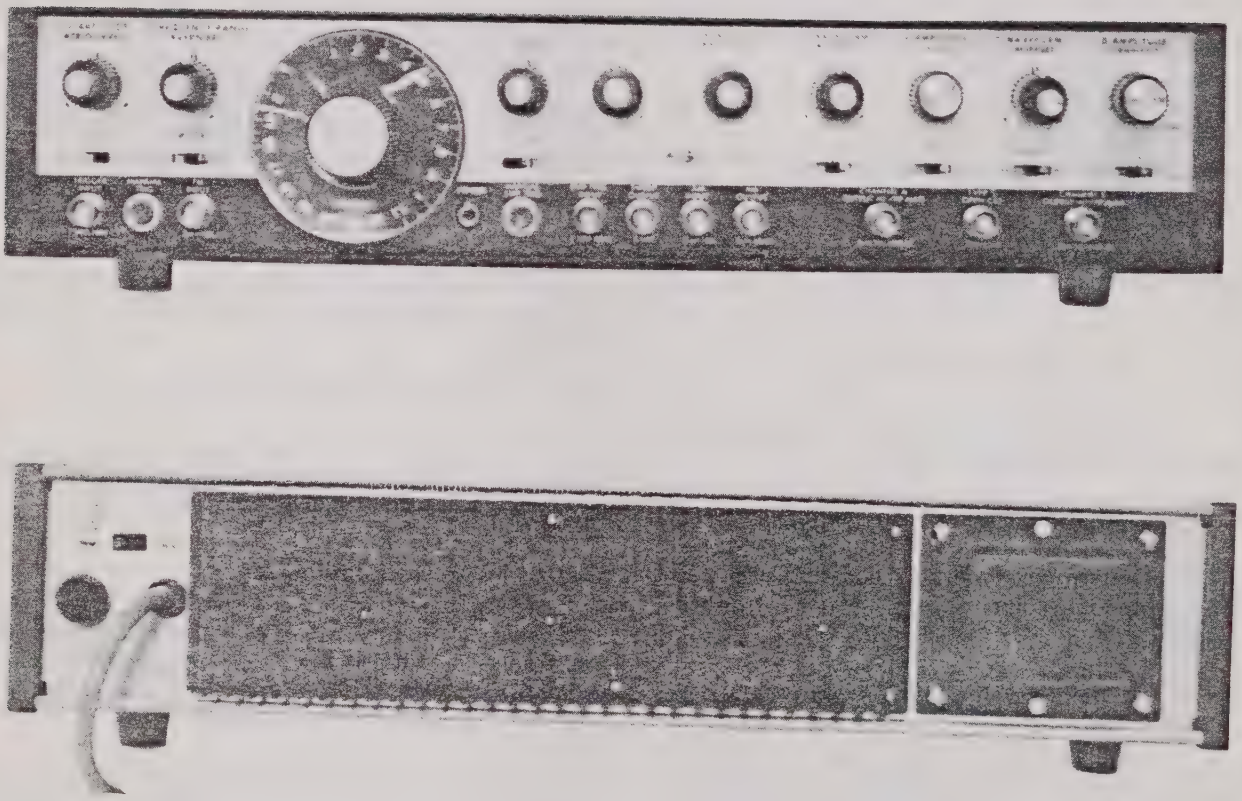


Figure 2-1. Model 410 Controls and Connectors

2.13 MODE Switch (Sweep Generator)

In the NORM position, the sweep generator continuously sweeps the percentage of the main generator frequency range determined by the width controls, at the rate determined by the duration controls.

In the TRIG position, one cycle of sweep output occurs for each sweep trigger signal applied or each time the MANUAL SWP TRIG pushbutton is depressed.

In the INTERNAL TRIG/GATE position, the sweep output triggers the main generator. The sweep generator is free running in this mode.

2.14 AM WAVEFORM Switch

Selects the waveform to be modulated by an external amplitude modulation signal.

2.15 BALANCE

Adjusts the balance between the positive and negative peaks of the AM waveform.

2.16 WAVEFORM Switch (Channel A)

Selects Channel A output waveform to be either sine (∿), square (⊓), triangle (⩘), inverted sweep (⩔) or amplitude modulated (AM).

2.17 WAVEFORM Switch (Channel B)

Selects Channel B output waveform to be either sine (∿), square (⊓), triangle (⩘), inverted Channel A output (INVCHA) or amplitude modulated (AM).

2.18 AMPLITUDE Control (Channel A and B)

Continuously varies the amplitude of the output waveform from 0.2 to 20 V p—p when terminated with 50 ohms.

2.19 OFFSET Control (Channel A and B)

Continuously adjusts dc level of the output waveform from -20 to +20 volts (see specifications for offset limitations).

2.20 OFFSET Switch (Channel A and B)

In the NAR position, the OFFSET control makes fine dc level adjustments.

In the WIDE position the dc level of the output waveform can be continuously adjusted from -20 to +20 volts.

In the 0 position the dc level of the output waveform is 0 volts.

2.21 600 OHM—0 DB/50 OHM—0 DB/ 50 OHM—40 DB (Impedance/ Attenuator) Switch (Channel A and B)

Selects the output impedance and attenuation.

2.22 MANUAL TRIG Pushbutton

In the triggered or gated mode, one cycle of the selected waveform occurs at the output each time the pushbutton is depressed.

2.23 MANUAL SWP TRIG Pushbutton

In the sweep trigger mode, one cycle of sweep output occurs each time the pushbutton is depressed.

2.24 TRIGGER INPUT

Input connector for an external trigger or gate signal. In the normal mode the main generator can be phase locked to an input to this connector, provided the two frequencies are within approximately 1% of each other.

NOTE: Phase-lock capabilities refer only to instruments with phase-lock modification (see main generator schematic 40000-402).

2.25 FM INPUT

Input connector for a frequency modulation signal.

2.26 SWEEP TRIG INPUT

Input connector for an external sweep trigger.

2.27 SWEEP OUTPUT

Output monitor for the sweep generator.

2.28 AM INPUT

Input for the amplitude modulation signal.

2.29 AM OUTPUT

Output monitor for the amplitude modulated waveform.

2.30 CHANNEL A and B OUTPUT

Output connectors for all waveforms indicated on Channel A and B WAVEFORM switches.

2.31 1 V PP OPEN CKT

Output connector for the 1 volt peak-to-peak square wave calibration signal. The output can also be used as a sync signal.

2.32 115/230 Volt Selector (Back Panel)

Selects the transformer primary configuration for either 115 or 230 volt input.

SECTION III

OPERATION

The following procedure provides a brief operational check of the instrument and an introduction to its controls.

3.1 EQUIPMENT (or equivalent) REQUIRED

a. Real-time oscilloscope with a dual trace plug-in, having a dc to 50 MHz bandwidth capability. Tektronix 546 with a 1A2 plug-in recommended.

b. Trigger and gate source with variable width control. Datapulse 101 Pulse Generator recommended.

c. Two 50 ohm, 5 watt terminations. Tektronix 011 - 0099 - 00 recommended.

d. Two 600 ohm, 5 watt termination.

e. Modulation source with a frequency capability of 1 kHz. Datapulse 401 Function Generator recommended.

3.2 MAIN GENERATOR OPERATION

CAUTION

Verify that the 115/230 volt slide switch on the back panel agrees with the line voltage prior to connecting the power plug.

a. Set the instrument controls as follows:

Control	Setting
FREQUENCY RANGE	X10 K
VERNIER	CAL
Frequency Dial	1
MODE (Main Generator)	NORM
POWER	off (down)
SWEEP DURATION	OFF
SWEEP WIDTH	OFF
CHANNEL A WAVEFORM	sine (∿)
CHANNEL B WAVEFORM	sine (∿)
Channel A AMPLITUDE	fully clockwise
Channel B AMPLITUDE	fully clockwise
Channel A OFFSET switch	0
Channel B OFFSET switch	0
Channel A Attenuator/ Impedance switch	0 DB/ 50 OHM
Channel B Attenuator/ Impedance switch	0 DB/ 50 OHM
Remaining controls	any position

b. Actuate the power switch to the "on" (up) position and verify that the pilot light illuminates.

c. Connect the 1 V PP⊓ connector to the vertical input of the oscilloscope and verify that a square wave of approximately 1 volt peak-to-peak is displayed.

d. Disconnect the 1 V PP⊓ output from the oscilloscope vertical input and connect it to the external trigger input.

Set the oscilloscope for external triggering.

e. Connect CHANNEL A OUTPUT and CHANNEL B OUTPUT to the vertical inputs of the dual-trace oscilloscope. Terminate both with 50 ohms at the oscilloscope.

f. Verify that sine waves of approximately 20 volts peak-to-peak amplitude are displayed on both traces.

g. Rotate both AMPLITUDE controls in a counterclockwise direction and verify that the amplitude of the waveforms decrease accordingly. Return the AMPLITUDE controls to the fully clockwise position.

h. Select the square (⊓), then the triangle (⩘) waveform on Channel A and B WAVEFORM switches and verify that the oscilloscope display changes accordingly.

i. Rotate the frequency dial from fully clockwise to fully counterclockwise and verify that the frequency of the displayed waveform changes accordingly.

j. Repeat step (i) for the remaining frequency ranges.

k. Set both AMPLITUDE controls to 1 and both OFFSET switches to WIDE.

l. Rotate both OFFSET controls from - to + and verify that the baselines of the waveforms are shifted from approximately -10 to +10 volts.

m. Set both OFFSET switches to NAR. Rotate both OFFSET controls from - to + and verify that the baselines are shifted from approximately -0.5 to +0.5 volts. Set both OFFSET switches to 0.

n. Rotate both AMPLITUDE controls to the fully clockwise position. Set both attenuator/impedance switches to -40 DB/50 OHM and verify that the amplitude of the displayed waveforms are decreased by a factor of 100.

o. Replace both 50 ohm terminations with 600 ohm terminations. Set both attenuator/impedance switches to 0 DB/600 OHMS and verify that the amplitude of the displayed waveform is approximately 20 volts peak-to-peak.

p. Reconnect the 50 ohm terminations and set the attenuator/impedance switches to 0 DB/50 OHM.

q. Set the Channel B WAVEFORM switch to INVCHA and Channel A WAVEFORM switch to sine (∿). Verify that Channel B output is the inverse of Channel A output.

3.3 SINE SQUARED OPERATION

a. Set the instrument controls the same as in step 3.2a, except set Channel B WAVEFORM switch INVCHA and Channel B AMPLITUDE control for approximately 5 volts peak-to-peak output.

b. Set the AM WAVEFORM switch to sine (∿) and jumper CHANNEL B OUTPUT to the AM INPUT.

c. Connect CHANNEL A OUTPUT and AM OUTPUT to the vertical inputs of the dual trace oscilloscope.

d. Adjust the AM BALANCE for equal peaks on the displayed waveform from the AM OUTPUT. Verify that the frequency of the waveform at the AM OUTPUT is twice that at CHANNEL A OUTPUT and that the amplitude is approximately 0.25 volts.

3.4 PULSE OPERATION

a. Set the instrument controls as follows:

Control	Setting
FREQUENCY RANGE	X0.1 K
VERNIER	CAL
Frequency Dial	1
MODE (Main Generator)	TRIG
SWEEP DURATION	0.1 S
Duration vernier	MIN
SWEEP WIDTH	OFF
SWEEP MODE	INTERNAL TRIG/GATE
Channel A WAVEFORM	square (⊓)
Channel A AMPLITUDE	fully clockwise
Channel A OFFSET switch	0
Channel A Attenuator/ Impedance switch	0 DB/ 50 OHM
Remaining controls	any position

b. Connect CHANNEL A OUTPUT to the oscilloscope vertical input. Terminate with 50 ohms at the oscilloscope.

c. Adjust TRIGGER LEVEL for triggering and verify that a pulse of approximately 20 volts peak-to-peak amplitude, 5 ms width and 10 Hz repetition rate is displayed on the oscilloscope.

d. Verify that the pulse width changes when the main generator frequency dial is varied and that the pulse repetition rate changes when the duration controls are varied (provided the sweep duration is not shorter than the main generator waveform period).

3.5 SWEEP GENERATOR OPERATION

a. Set the instrument controls as follows:

Control	Setting
FREQUENCY RANGE	X10 K
VERNIER	CAL
Frequency Dial	1
MODE (Main Generator)	NORM
SWEEP DURATION	10 MS
SWEEP MODE	NORM
Duration vernier	MIN
SWEEP WIDTH	100%
Width vernier	MAX
Channel A WAVEFORM	inverted sweep (⋁)
Channel A AMPLITUDE	fully clockwise
Channel A OFFSET switch	0
Channel A Attenuator/ Impedance switch	0 DB/ 50 OHM
Remaining controls	any position

b. Connect SWEEP OUTPUT and CHANNEL A OUTPUT to the vertical inputs of the dual-trace oscilloscope. Terminate CHANNEL A OUTPUT with 50 ohms at the oscilloscope. Trigger the oscilloscope with the SWEEP OUTPUT.

c. Verify that the repetition rate of the sweep output is approximately 10 Hz

and the amplitude is 5 volts peak-to-peak. Verify that Channel A output is approximately 10 volts peak-to-peak and is the inverse of the sweep output.

d. Rotate the duration vernier in a counterclockwise direction and verify that the sweep duration increases.

e. Select the remaining duration ranges, verifying that the sweep duration changes accordingly and that the duration vernier functions for all ranges.

f. Set the instrument control the same as in step (a), except set Channel A WAVEFORM switch to square (⊓), SWEEP DURATION to 10 S and width vernier to the fully counterclockwise position.

g. Expand the oscilloscope display for approximately 3 cycles of square wave (approximately 0.1 ms).

h. Set the duration vernier to MIN and width vernier to MAX and verify that the period of the square wave decreases from approximately 0.1 to 0.05 ms at a 10 second rate.

NOTE: In steps (i) and (j), set the width verniers to minimum when determining the initial square wave period.

i. Set the FREQUENCY RANGE selector to X1 K and the SWEEP WIDTH switch to 10%. Verify that the period of the square wave decreases from approximately 1 ms to 0.9 ms at a 10 second rate.

j. Set the SWEEP WIDTH to 1% and verify that the period of the square wave decreases from approximately 1 ms to 0.99 ms at a 10 second rate.

3.6 AM and FM OPERATION

a. Set the instrument controls as follows:

Control	Setting
FREQUENCY RANGE	X10 K
VERNIER	CAL
Frequency Dial	1
MODE (Main Generator)	NORM
SWEEP DURATION	OFF
Channel A WAVEFORM	AM
Channel B WAVEFORM	AM
AM WAVEFORM	sine (∿)
AM BALANCE	mid-range
Channel A AMPLITUDE	fully clockwise
Channel B AMPLITUDE	fully clockwise
Remaining controls	any position

b. Set the external modulation source for a 1 kHz, 2 volt peak-to-peak sine wave and connect its output to the AM input. Trigger the oscilloscope from the AM source.

c. Connect the AM OUTPUT to the oscilloscope vertical input and verify that an amplitude modulated sine wave of approximately 0.2 volts peak-to-peak is displayed.

d. Select the other three waveforms on the AM WAVEFORM switch and verify that all can be modulated.

e. Set the AM WAVEFORM switch to sine (∿) and connect CHANNEL A OUTPUT and CHANNEL B OUTPUT to the vertical inputs of the dual-trace oscilloscope. Terminate the OUTPUTS with 50 ohms at the oscilloscope input.

f. Increase the amplitude of the external modulation source to +5 volts peak-to-peak (5 volt sine wave offset by +25 volt dc) and verify that amplitude modulation signals of approximately 20 volts peak-to-peak are displayed. Set the offset of the modulation source to 0 volts dc and verify that the modulated output is a suppressed carrier. Verify that the amplitude is approximately 10 volts peak-to-peak.

g. Verify that the peaks of the modulated waveform can be balanced with the AM BALANCE control.

h. Reduce the amplitude of the external modulation source to 2 volts peak-to-peak and connect it to the FM INPUT.

i. Set WAVEFORM A and WAVEFORM B switches to sine (∿) and verify that Channel A and B outputs are frequency modulated.

3.7 MAIN GENERATOR TRIGGER and GATE OPERATION

a. Set the instrument controls as follows:

Control	Setting
FREQUENCY RANGE	X10 K
VERNIER	CAL
Frequency Dial	1
TRIG POLARITY	+
TRIG SENSITIVITY	mid-range
START/STOP	mid-range
MODE (Main Generator)	TRIG
SWEEP DURATION	OFF
Channel A WAVEFORM	sine (∿)
Channel A OFFSET	0
Channel A AMPLITUDE	fully clockwise
Channel A Attenuator/-Impedance switch	0 DB/-50 OHM
Remaining controls	any position

b. Trigger the oscilloscope with the 1 V PP⎍output and connect CHANNEL A OUTPUT to one of the vertical inputs. Terminate with 50 ohms at the oscilloscope.

c. Depress MAN TRIG several times and verify that one cycle of sine wave is displayed each time the button is depressed.

d. Set the external trigger source for a 1 kHz repetition rate; 0.5 ms width and a 2 volt peak amplitude. Connect the trigger source to the TRIGGER INPUT and to the other vertical input of the oscilloscope. Trigger the oscilloscope from the trigger source.

e. Verify that the sine wave output is triggered by the leading edge of the trigger signal and that it occurs at the repetition rate of the trigger signal.

f. Set the TRIG POLARITY switch to – and verify that the sine wave output is triggered by the trailing edge of the trigger signal.

g. Set the TRIG POLARITY switch to + and turn the START/STOP control to –. Verify that the displayed waveform has a positive peak of approximately 10 volts and a negative peak of less than 1 volt.

h. Turn the START/STOP control to + and verify that the waveform has a negative peak of approximately –10 volts and a positive peak of less than 1 volt.

i. Rotate the START/STOP control to mid-range and set the MODE switch to GATE. Verify that the sine wave output occurs for the length of time corresponding to the width of the gate signal.

NOTE: The width of the gated output is slightly longer than the gate signal since the last cycle of the waveform will always be completed.

3.8 SWEEP GENERATOR TRIGGER OPERATION

a. Set the instrument controls as follows:

Control	Setting
FREQUENCY RANGE	X10 K
VERNIER	CAL
Frequency Dial	1
MODE (Main Generator)	NORM
SWEEP DURATION	10 S
Duration vernier	MIN
SWEEP WIDTH	100%
Width vernier	MAX
SWEEP MODE	TRIG
Remaining controls	any position

b. Connect the SWEEP OUTPUT to the vertical input of the oscilloscope. Depress the MANUAL SWP TRIG pushbutton several times and verify that the sweep output occurs each time the pushbutton is depressed.

c. Connect the external trigger source to the SWP TRIG INPUT and to the other oscilloscope vertical input. Set the SWEEP DURATION switch to 100 μs.

d. Set the external trigger source to 1 kHz repetition rate, 2 volt amplitude and a 10 μs width. Verify that the sweep output occurs at the repetition rate of the trigger source.

e. Remove the external trigger source and set the SWEEP MODE switch to INTERNAL TRIG/GATE. Set the main generator MODE switch to TRIG and the sweep duration to 1 ms.

f. Monitor CHANNEL A OUTPUT and verify that the output is triggered at the rate of the sweep duration switch setting.

SECTION IV

MAINTENANCE

4.1 PREVENTIVE MAINTENANCE

Proper care and correct use with regularly scheduled inspections provide the best protection against unnecessary repairs and down time. The Datapulse Model 410 is a sensitive laboratory instrument and should not be exposed to severe environmental conditions either in use or in storage. Contaminating or damaging exposure must be avoided at all times if long life and uninterrupted service are expected.

4.1.1 Inspection

Remove the top and bottom covers by removing 2 flat head Phillips screws on each cover. The side panels should normally be left on but may be taken off by removing two screws from the rear end block. Inspect for dirt and corrosion and for loose, broken, or burnt parts and wiring. Circuit board discoloration caused by heat may usually be disregarded unless the instrument is inoperative. Inspection intervals should be based on frequency of use and the severity of the environment to which the instrument is exposed.

4.1.2 Cleaning

Accumulated dust and dirt should be removed as often as required. Use either low velocity dry air or a soft nonmetallic brush to clear the interior of foreign matter. Clean dirty parts with a solvent such as trichlorethylene using a soft cloth, and a cotton tipped applicator for narrow spaces.

4.1.3 Recalibration

The instrument is correctly calibrated when it leaves the factory. However, calibration should be checked at regularly scheduled intervals of either accumulated operating hours or calendar time; 500 operating hours or six month intervals is recommended. Refer to paragraph 4.3 for complete calibration instructions.

4.2 PARTS REPLACEMENT

A procedure should be carefully thought out before a part is removed to avoid unnecessary disassembly and accidental damage. Use only direct replacements for parts affecting performance. Transistors temporarily removed should be returned to their original sockets unless defective. Replacement of some parts will necessitate partial recalibration.

4.2.1 Power Transistors

The power transistors for the dc power supplies and the output amplifier are mounted on the back panel and side rail for heat dissipation. Fiber bushings and mica washers are used to electrically insulate the case (collector) from the heat sink (ground) and a thin film of thermal compound (Wakefield No. 122) is applied to both sides of the mica washers to insure proper thermal conductivity. Incorrectly installed, the transistors may either short out or overheat and fail.

4.2.2 Soldering

Only experienced technicians should replace soldered parts. Printed circuits are vulnerable to excess heat as are many diodes and transistors. The following recommendations should be taken into consideration when replacing soldered parts:

a. Use small diameter rosin core solder and a 35 to 40 watt iron with a wedge

or pointed tip, 1/16 to 1/8 inch wide. The tip must be clean and properly tinned with excess solder removed.

b. Obviously defective parts may be clipped out so their leads can be conveniently unsoldered from the board.

c. Solder only on the circuit side of the board; not on the component side.

d. Apply the tip of the iron directly to the solder joint, at the eyelet, just long enough for the solder to flow.

e. Avoid bringing the iron into contact with the circuit board; overheating will cause the conductor to lift from the board.

f. Use a solder sipper (or some other means) to remove excess solder first when unsoldering a lead, particularly where a lead is bent over, so that it can be straightened before it is pulled out.

g. When a lead is free, clean the hole and remove excess solder, using a solder sipper or a sharp object such as a tooth pick or pointed tool.

h. To prevent heat damage when soldering heat sensitive components, use a heat sink or long nose pliers to grip the lead between the part and the board.

i. Clean the area thoroughly after soldering.

4.3 CALIBRATION

NOTE: To insure maximum performance and long term calibration, no adjustments should be made before a one-half hour warm-up period is complete. Since the warm-up period is to allow for internal temperature stabilization, the instrument top cover should be slid back only while actual adjustments are being made.

4.3.1 Equipment (or equivalent) Required

a. Oscilloscope with a band-pass capability of dc to 50 MHz. Tektronix 546 with a Type 1A2 plug-in recommended.

b. Digital voltmeter capable of reading units of millivolts. Systron-Donner 7000A recommended.

c. Electronic counter capable of reading 2 MHz. Systron-Donner 6150 recommended.

d. Distortion analyzer. Hewlett-Packard 332A recommended.

e. Variable autotransformer.

f. Two fifty ohm, 5 watt terminations. Tektronix 011 - 0099 - 00 recommended.

g. Low voltage dc source capable of 5 volts output.

h. Four 50 ohm coaxial cables terminated with BNC connectors.

i. Pulse generator with a variable width control and 10 kHz repetition rate capability. Datapulse Model 101 recommended.

NOTE: See Figure 4-1 and 4-2 for location of calibration adjustments and test points. Capacitor C1 and C3 are located on the frequency range switch and capacitor C812 is located on the sweep duration switch.

4.3.2 Power Supply Calibration

a. Connect the instrument to the autotransformer.

CAUTION

Verify that the 115/230 volt slide switch on the back panel agrees with the line voltage prior to connecting the power plug.

b. Set the autotransformer for 115 or 230 volts, then actuate the POWER switch.

c. Connect the digital voltmeter between the +15 volts test point and chassis ground. Adjust R31 for +15.0 volts.

d. Vary the line voltage +10%, then -10% and verify that the +15 volt supply does not change more than ±15 millivolts.

e. Connect the digital voltmeter between -15 volt test point and chassis ground and verify a reading of -15 ±0.3 volts.

f. Vary the line voltage +10%, then -10% and verify that the -15 volt supply does not change more than ±15 millivolts.

g. Connect the digital voltmeter between the +30 volt test point and chassis ground and verify a reading of +30 ±0.3 volts.

h. Vary the line voltage +10%, then -10% and verify that the +30 volt supply does not change more then ±30 millivolts.

i. Connect the digital voltmeter between -30 volt test point and chassis ground and verify a reading of -30 ±0.5 volts.

j. Vary the line voltage +10%, then -10% and verify that the -30 volt supply does not change more then ±30 millivolts.

k. Using the oscilloscope, check the ripple on all four power supplies. Vary the line voltage +10% and -10% while making the ripple check. Ripple should not exceed 15 millivolts peak-to-peak.

4.3.3 Square Wave Calibration

a. Set the instrument controls as follows:

Control	Setting
FREQUENCY RANGE	X1
VERNIER	CAL
Frequency Dial	0.1
MODE (Main Generator)	NORM
SWEEP DURATION	OFF
SWEEP WIDTH	OFF
Remaining controls	any position

b. Connect the 1 V PP⌇connector to the input of the digital voltmeter. Set the voltmeter to read dc voltage.

NOTE: Voltmeter reading will shift from +0.5 to -0.5 volts approximately every 5 seconds.

c. Adjust R229 for a positive peak of +0.500 ±0.001 volts and R232 for a negative peak of -0.500 ±0.001 volts.

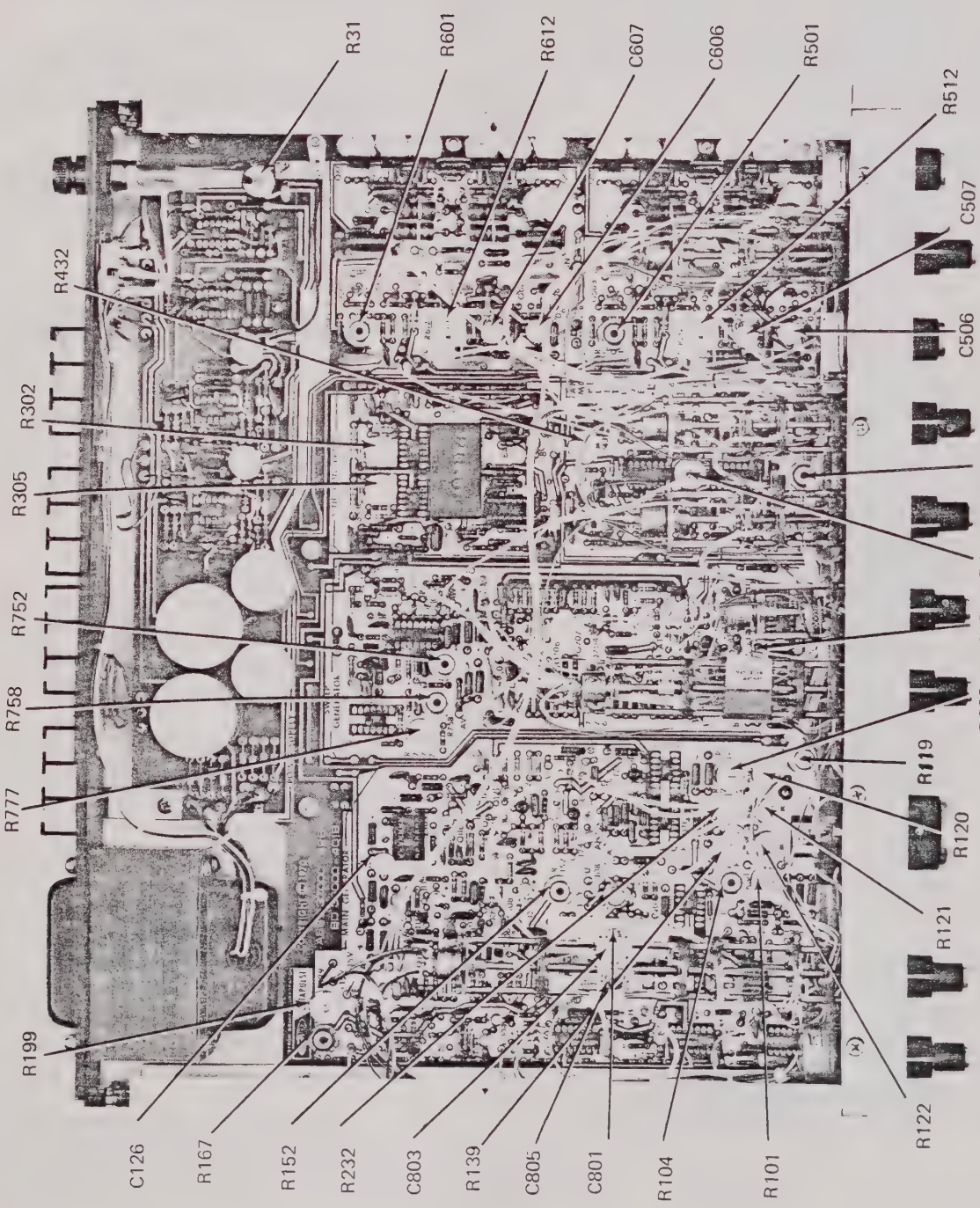


Figure 4-1. Model 410 Top View.

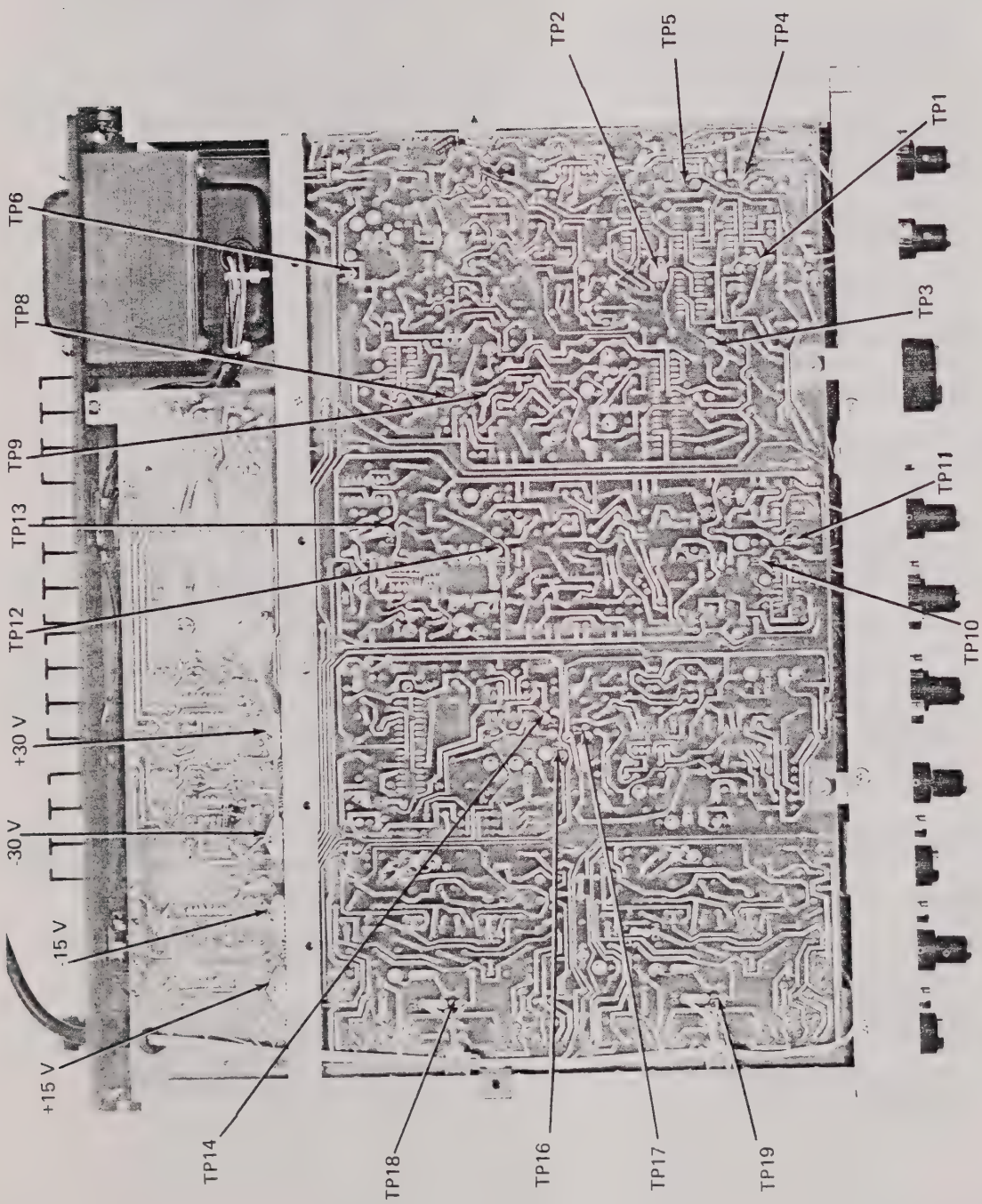


Figure 4-2. Model 410 Bottom View.

d. Set the FREQUENCY RANGE selector to X10 K and the frequency dial to 1.

e. Disconnect the 1 V PP ⊓ from the voltmeter and connect it to the oscilloscope vertical and trigger inputs.

f. Select external triggering on the oscilloscope and set the trigger slope to positive. Set the sweep rate control to display exactly one cycle of square wave.

g. Set the sweep magnifier to X10 and position the square wave so that the negative-going edge is on the center graticule. Set the oscilloscope trigger slope to negative.

NOTE: Do not reposition the square wave with the oscilloscope controls.

h. Adjust R139, if necessary, to reposition the positive-going edge on the center graticule.

i. Switch the oscilloscope trigger slope from negative to positive several times and verify that both edges remain on the center graticule. If readjustment is necessary, always set the trigger slope to negative before adjusting R139.

4.3.4 Sine Wave Distortion Calibration

4.3.4.1 Method I

a. Set the instrument controls as follows:

Control	Setting
FREQUENCY RANGE	X10 K
VERNIER	CAL
Frequency Dial	2
MODE (Main Generator)	NORM
Channel A WAVEFORM	sine (∿)
Channel A OFFSET	0
Channel A Attenuator/ Impedance switch	0 DB/ 50 OHM
Channel A AMPLITUDE	fully clockwise
SWEEP DURATION	OFF
SWEEP WIDTH	OFF
Remaining controls	any position

b. Connect CHANNEL A OUTPUT to the distortion analyzer input. Terminate with 50 ohms at the distortion analyzer.

c. Adjust R302 and R305 for minimum distortion.

d. Set the frequency dial to 0.2 and adjust R152 for minimum distortion.

e. Return the frequency dial to 2 and verify that the distortion is less than 0.25%.

NOTE: After completion of the entire calibration procedure recheck sine wave distortion. Readjust, if necessary.

4.3.4.2 Method II

a. Set the instrument controls the same as in step 4.3.4.1a, except set the frequency dial to 1.

b. Connect TP15 to the oscilloscope vertical input.

c. Using the frequency dial and VERNIER, adjust for minimum signal amplitude on the oscilloscope.

NOTE: TP15 is the output of a notch filter that rejects only 10 kHz, therefore, the oscilloscope display represents sine wave distortion.

d. First adjust R302 and R305 for minimum signal amplitude; then adjust R152 for minimum signal amplitude.

4.3.5 Frequency Range and Dial Calibration

a. Set the instrument controls as follows:

Control	Setting
FREQUENCY RANGE	X1 K
VERNIER	CAL
Frequency Dial	0.2
Channel A WAVEFORM	square (⊓)
Channel A OFFSET	0
Channel A AMPLITUDE	fully clockwise
SWEEP DURATION	OFF
SWEEP WIDTH	OFF
TRIGGER POLARITY	+
TRIGGER LEVEL	+
Remaining controls	any position

NOTE: For instruments with phase-lock modification, a dial accuracy error of approximately 1% will occur if the trigger level and trigger polarity are not in the same sense.

b. Connect CHANNEL A OUTPUT to the counter input. Terminate with 50 ohms at the counter.

c. Adjust the frequency dial for a reading of 5 ±0.05 ms. Loosen the Allen screw on the dial and position the dial to approximately 0.2, then retighten the Allen screw.

d. Set the frequency dial to exactly 0.2 and adjust R104 for 5 ±0.005 ms.

e. Set the frequency dial to 2 and adjust R122 for 2 kHz ±2 Hz.

f. Return the dial to 0.2 and verify a reading of 5 ±0.05 ms. If reading is out of tolerance, repeat step (d) and (e) until both readings are in tolerance.

g. Set the frequency dial at the following positions and verify that readings are within ±1% of the dial setting.

Dial Setting	Frequency
0.2	5 ms ±0.05 ms
0.5	500 Hz ±5 Hz
1	1 kHz ±10 Hz
1.6	1.6 kHz ±16 Hz
2	2 kHz ±20 Hz

h. Set the FREQUENCY RANGE selector to X0.1 K and position the frequency dial to 2. Adjust R121 for a reading of 5 ±0.005 ms.

i. Set the frequency dial at the following positions and verify that the readings are within ±1% of the dial setting.

Dial Setting	Period
0.2	50 ms ±0.5 ms
0.5	20 ms ±0.2 ms
1	10 ms ±0.1 ms
1.6	6.25 ms ±0.06 ms
2	5 ms ±0.05 ms

j. Set the FREQUENCY RANGE selector to X10 and position the frequency dial to 2. Adjust R120 for a reading of 50 ±0.05 ms.

k. Set the frequency dial at the following positions and verify that the readings are within ±1% of the dial setting.

Dial Setting	Period
0.2	500 ms ±5 ms
0.5	200 ms ±2 ms
1	100 ms ±1 ms
1.6	62.5 ms ±0.62 ms
2	50 ms ±0.5 ms

l. Set the FREQUENCY RANGE selector to X 1 and position the frequency dial to 2. Adjust R119 for a reading of 500 ±0.5 ms. Note that readjustment of R119 may be necessary since the X 0.1 and X 0.01 ranges are also affected by this setting.

m. Set the frequency dial at the following positions and verify that the readings are within ±1% of the dial setting.

Dial Setting	Period
0.2	5 s ±50 ms
0.5	2 s ±20 ms
1	1 s ±10 ms
1.6	625 ms ±6.25 ms
2	500 ms ±5 ms

n. Set the FREQUENCY RANGE selector to X10 K and position the frequency dial to 2. Adjust C805 for a reading of 20 kHz ±200 Hz.

o. Set the frequency dial at the following positions and verify that the readings are within ±1% of the dial setting.

Dial Setting	Frequency
0.2	2 kHz ±20 Hz
0.5	5 kHz ±50 Hz
1	10 kHz ±100 Hz
1.6	16 kHz ±160 Hz
2	20 kHz ±200 Hz

p. Set the FREQUENCY RANGE selector to X1 M and position the frequency dial to 0.2. Adjust C801 for a reading of 200 kHz ±4 kHz.

q. Position the frequency dial to 2 and adjust C126 for 2 MHz ±40 kHz.

r. Return the frequency dial to 0.2 and verify that the reading is still in tolerance. If not, repeat step (n) and (o) for a best case in tolerance reading.

s. Set the frequency dial at the following positions and verify that the readings are within ±2% of the dial setting.

Dial Setting	Frequency
0.2	200 kHz ±4 kHz
0.5	500 kHz ±10 kHz
1	1 MHz ±20 kHz
1.6	1.6 MHz ±32 kHz
2	2 MHz ±40 kHz

t. Set the FREQUENCY RANGE selector to X100 K and position the frequency dial to 2. Adjust C803 for a reading of 200 kHz ±2 kHz.

u. Set the frequency dial at the following positions and verify that the readings are within 1% of the dial setting.

Dial Setting	Frequency
0.2	20 kHz ±200 Hz
0.5	50 kHz ±10 kHz
1	100 kHz ±1 kHz
1.6	160 kHz ±1.6 kHz
2	200 kHz ±2 kHz

4.3.6 FM Calibration

a. Set up the equipment and the instrument controls the same as in step 4.3.5 (a) and (b).

b. Connect the low voltage dc source to the FM INPUT. Set the voltage source to 0 volts output.

c. Verify that the counter reads 5 ±0.05 ms.

d. Set the low voltage dc source to 4.5 volts and adjust R101 for a reading of 2 kHz ±1%.

4.3.7 Output Amplifier Calibration

a. Set the instrument controls as follows:

Control	Setting
FREQUENCY RANGE	X10 K
VERNIER	CAL
Frequency Dial	1
SWEEP DURATION	OFF
SWEEP WIDTH	OFF
Channel A WAVEFORM	sine (∿)
Channel B WAVEFORM	sine (∿)
Channel A OFFSET	0
Channel B OFFSET	0
Channel A AMPLITUDE	fully counterclockwise
Channel B AMPLITUDE	fully counterclockwise
Channel A Attenuator/ Impedance switch	50 OHM/ 0 DB
Channel B Attenuator/ Impedance switch	50 OHM/ 0 DB

b. Connect CHANNEL A OUTPUT to the digital voltmeter input. Set the voltmeter to read dc voltage.

c. Adjust R601 for 0.00 volts.

d. Set the voltmeter to read ac voltage. Rotate Channel A AMPLITUDE to the fully clockwise position and adjust R612 for a sine wave amplitude of 14.8 volts rms.

e. Disconnect CHANNEL A OUTPUT from the voltmeter and connect to the vertical input of the oscilloscope. Using the sine wave as a 42 volt peak-to-peak reference, verify that the triangle and square waveforms are greater than 40 volts peak-to-peak.

f. Set the FREQUENCY RANGE selector to X1 M and position the frequency dial to 1. Terminate CHANNEL A OUTPUT with 50 ohms at the oscilloscope.

g. Select the square (⊓) waveform and adjust C606 and C607 for the desired overshoot/rise time compensation.

h. Verify that the rise time is less than 50 ns.

NOTE: Rise time may be adjusted to a higher value if a smoother square wave is desired.

i. Set the FREQUENCY RANGE selector to X10 K and the frequency dial to 1. Set Channel B WAVEFORM to sine (∿).

j. Connect CHANNEL B OUTPUT to the input of the digital voltmeter. Set the voltmeter to read dc voltage. Adjust R501 for 0.00 volts.

k. Set the voltmeter to read ac voltage. Rotate Channel B AMPLITUDE to the

fully clockwise position. Adjust R512 for a sine wave amplitude of 14.8 volts rms.

m. Disconnect CHANNEL B OUTPUT from the voltmeter and connect it to the vertical input of the oscilloscope. Using the sine wave as a 42 volt peak-to-peak reference, verify that the triangle and square waveforms are greater than 40 volts peak-to-peak.

n. Set the FREQUENCY RANGE selector to X1 M and position the frequency dial to 1. Terminate CHANNEL B OUTPUT with 50 ohms at the oscilloscope. Select the square (⊓) waveform and adjust trim capacitor C506 and C507 for the desired overshoot/rise time compensation.

o. Verify that the rise time is less than 50 ns.

4.3.8 Trigger Calibration

a. Set the instrument controls as follows:

Control	Setting
FREQUENCY RANGE	X10 K
VERNIER	CAL
Frequency Dial	1
Channel A WAVEFORM	sine (∿)
Channel A AMPLITUDE	fully clockwise
SWEEP DURATION	OFF
SWEEP WIDTH	OFF
MODE (Main Generator)	TRIG
START/STOP	mid-range

b. Connect CHANNEL A OUTPUT to the input of the oscilloscope.

c. Set the START/STOP and TRIG LEVEL fully clockwise. Adjust R167 and R199 fully clockwise.

d. Verify that a sine wave is displayed on the oscilloscope. Adjust R167 counterclockwise until the sine wave disappears, then clockwise until the sine wave just appears.

e. Adjust R199 counterclockwise until the sine wave disappears, then clockwise until the sine wave just appears.

f. Adjust R167 counterclockwise to slightly beyond the point where the sine wave disappears.

4.3.9 Sweep Generator Calibration

a. Set the instrument controls as follows:

Control	Setting
SWEEP DURATION	10 MS
Duration vernier	MIN
SWEEP WIDTH	10%
SWEEP MODE	NORM
Width vernier	MAX
Remaining controls	any position

b. Connect the SWEEP OUTPUT to the vertical and external trigger inputs of the oscilloscope. Set the oscilloscope for external triggering. Adjust R777 for a sweep signal amplitude of 5 volts peak-to-peak.

c. Adjust R758 so that the sweep signal starts at 0 volts.

d. Set the SWEEP DURATION to 10μs and the width vernier to MIN. Adjust C812 for a sweep duration of 10 μs.

e. Monitor point AV (reference drawing 37000 - 928) with the oscilloscope and adjust R752 for sweep signal amplitude of 5 V p—p.

f. Set the SWEEP MODE switch to TRIG. Monitor point AV and adjust R726 for 0 volts dc on the oscilloscope.

4.3.10 AM Circuit Calibration

a. Set the instrument controls as follows:

Control	Setting
FREQUENCY RANGE	X10 K
VERNIER	CAL
Frequency Dial	1
AM WAVEFORM	square (⊓)
BALANCE	mid-range
SWEEP DURATION	OFF
Channel A WAVEFORM	AM
Channel A AMPLITUDE	fully clockwise
Channel A Attenuator/ Impedance switch	0 DB/ 50 OHM
Remaining controls	any position

b. Monitor the wiper of R831 on the oscilloscope and adjust AM BALANCE control for 0.0 volts dc.

c. Connect CHANNEL A OUTPUT to the vertical input of the oscilloscope. Terminate with 50 ohms at the oscilloscope.

d. Adjust R406 for an ac null on the oscilloscope.

e. Adjust R419 for a dc null on the oscilloscope.

f. Using the low voltage dc source apply +5.0 volts to the AM INPUT and adjust R432 for an amplitude of 20 volts peak-to-peak.

4.4 SPECIFICATION VERIFICATION

This section is designed to assist in comparing the Model 410 with its published specification.

4.4.1 Equipment (or equivalent) Required

The same equipment listed in paragraph 4.3.1 can be used in these checks.

4.4.2 Dial Accuracy Checks

a. Connect CHANNEL A OUTPUT to the input of the counter.

b. Set the instrument controls as follows:

Control	Setting
FREQUENCY RANGE	X0.01
VERNIER	CAL
Frequency Dial	0.2
Channel A WAVEFORM	square (⊓)
Channel A OFFSET	0
Channel A AMPLITUDE	fully clockwise
SWEEP DURATION	OFF
SWEEP WIDTH	OFF
Remaining controls	any position

c. Set the instrument for the dial and range settings in Table 4 - 1 and verify the counter indications.

4.4.3 Sine Distortion Check

a. Connect CHANNEL A OUTPUT to the input of the distortion analyzer. Terminate with 50 ohms at the distortion analyzer.

Table 4 - 1. Dial Accuracy Check

Dial	Range	Counter Indication	
0.2	X0.01	416 s to 625 s	NOTE R119 adjustment affects dial accuracy of X1, X0.1, and X0.01 ranges.
1	X0.01	96 s to 104 s	
2	X0.01	49s to 51 s	
0.2	X0.1	41.6 s to 62.5 s	
1	X0.1	9.6 s to 10.4 s	
2	X0.1	4.9 s to 5.1 s	
0.2	X1	4.9 s to 5.1 s	
1	X1	980 ms to 1.02 s	
2	X1	490 ms to 510 ms	
0.2	X10	495 ms to 505 ms	
1	X10	99 ms to 101 ms	
2	X10	49.5 ms to 50.5 ms	
0.2	X0.1 K	49.5 ms to 50.5 ms	
1	X0.1 K	9.9 ms to 10.1 ms	
2	X0.1 K	4.95 ms to 5.05 ms	
0.2	X1 K	4.95 ms to 5.05 ms	
1	X1 K	990 Hz to 1010 Hz	
2	X1 K	1980 Hz to 2020 Hz	
0.2	X10 K	1980 Hz to 2020 Hz	
1	X10 K	9.90 kHz to 10.10 kHz	
2	X10 K	19.80 kHz to 20.20 kHz	
0.2	X100 K	19.80 kHz to 20.20 kHz	
1	X100 K	99.00 kHz to 101.0 kHz	
2	X100 K	198.0 kHz to 202.0 kHz	
0.2	X1 M	196.0 kHz to 204.0 kHz	
1	X1 M	980.0 kHz to 1.02 MHz	
2	X1 M	1.96 MHz to 2.04 MHz	

c. Set the frequency dial to 0.02 (first dial increment) and record the counter indication.

NOTE: If no output is present, rotate dial slightly counterclockwise until minimum frequency is obtained.

d. Set the low voltage dc source to +5 volts and verify that the frequency increases by a factor of 1000.

4.5 TROUBLESHOOTING

Before assuming that the instrument has a malfunction, double check the control settings and power connections. Verify also that the instrument has been properly calibrated since uncalibrated instruments may often exhibit some of the same symptoms as one that is malfunctioning.

4.5.1 Disassembly Instructions

To gain access to the circuit components and printed circuit board, remove the four flat-head screws (2 in each cover) from the top and bottom covers and slide the covers off. In most situations, it is not necessary to remove the side covers and rails. However, if the need arises, the side covers may be removed by removing the two flat-head screws from the rear end blocks and sliding the side covers off. To remove the side rails, remove the two flat-head screws from the front end blocks, then remove the round head screws (one at each end of the rails) from the upper and lower rails.

4.5.2 General Troubleshooting Instructions

Since the circuitry that generates the triangle and square waveforms is a closed loop (integrator, comparator and squaring circuit), it is often difficult to determine just where the malfunction exists. The function of this paragraph is to set down some general troubleshooting guidelines that will help to localize the malfunction. Usually when the closed loop has a malfunction, no waveforms are present at the output and the output is offset to a dc level of + or -15 volts. If these conditions exist, perform the following steps:

a. Set the FREQUENCY RANGE switch to X10 K and the frequency dial to 2. Verify the voltage at TP2 is approximately +10.8 V and approximately -10.8 V at TP3. If the voltages are present, go to step (b); if not, troubleshoot the frequency control circuit (Z103 through Z106 and associated circuitry).

b. Check the voltage at the input (pin 11 of Z108) and the output (TP6) of the integrator. If the input voltage (approximately + or -1.7 V) and the output voltage (approximately + or -10 V) are opposite polarity, go to step (c). If the input and output are the same polarity or opposite polarity with the output reduced in amplitude (< 5 V), the fault is in the integrator (Q105A through Q115).

c. Monitor TP3 with an oscilloscope. Measure the voltage between pin 4 of Z109 and ground with a digital voltmeter and note the polarity. Using a low voltage dc source, apply approximately 1 V dc (the same polarity as noted above) between pin 3 and ground. If the voltage at TP3 shifts levels (positive to negative, or negative to positive) go to step (d); if not, troubleshoot the comparator (Z109 and associated circuitry).

d. If the instrument passes steps (a), (b) and (c), troubleshoot the squaring circuit. For specific problems and their probable causes, see Table 4 - 2.

Table 4-2. Troubleshooting.

Symptom	Probable Cause	Check
1. No output and pilot lamp does not illuminate.	1. No input power, or power supply malfunction.	1. Check line cord connection, fuse and line voltage. If all are correct, troubleshoot the power supply.
2. Pilot lamp illuminated but no waveforms present at output and baseline is at 0 volts.	2. No input from waveform switch or output amplifier is inoperative.	2. Check for waveform at the base of Q1 (output amplifier). If waveform is not present, troubleshoot the waveform switch. If waveform is present, troubleshoot the output amplifier.
3. No waveforms present at output and baseline is + or -15 volts dc.	3. Closed loop consisting of integrator, comparator and squaring circuit.	3. Check the voltage at the input (pin 11 of Z108) and the output (TP6) of the integrator. If the input (+ or -1.7 V) and the output (+ or -10 V) are the same polarity, the integrator is malfunctioning. If the input and output voltages are opposite polarity, but the amplitude at the output is less than 5 volts, check the integrator output transistors Q114 and Q115 and their associated circuitry. For all other cases of integrator input and output voltages, the comparator and/or the squaring circuits are faulty.
4. Sawtooth output in the triangle (⩘) position. Very narrow pulses in the square wave (⊓) position.	4. Positive or negative frequency control voltage missing.	4. Check TP7 and TP8 for proper voltage. Check diode bridge network for open diode.
5. All frequency ranges reading high.	5. Open feedback loop to Z104.	5. Check for open diode across terminals 7 and 8 of Z108. Check Q102A/B, Z105 and associated circuitry.
6. Positive and negative peaks of all waveforms unequal and all waveforms unsymmetrical.	6. Z110 or Z111 malfunctioning.	6. Check the supply voltages to Z110 and Z111. If voltages are correct, replace Z110 or Z111.
7. Triangle and square wave present at the output but sine wave is missing.	7. Sine converter or sine amplifier inoperative.	7. Check for correct voltages (approximately 3 volts) at pin 10 of Z301 and Z302. Check the sine shaper output at TP14. If

Table 4-2 (cont.)

		(7) sine wave is not present, replace the sine shaper. If sine wave is present troubleshoot the sine amplifier.
8. Sine wave output distorted.	8. Sine shaper, sine amplifier or output amplifier faulty.	8. Check distortion at TP14. If distortion is >0.18% replace the sine shaper. If not, check the distortion at the output of the sine amplifier. If distortion is >0.25, troubleshoot the sine amplifier; if not, troubleshoot the output amplifier.
9. Sine wave amplitude low but triangle and square waveform amplitude correct.	9. Sine converter or sine amplifier faulty.	9. Check pin 10 of Z301 and Z302 for +3 and -3 volts respectively. Check for a 6 volt sine wave at TP8. If voltage readings are correct, troubleshoot sine amplifier.
10. Amplitudes of all waveforms low.	10. Output amplifier faulty, or square wave input to comparator low.	10. Check waveform amplitudes at the input of the output amplifier. If amplitudes are 10 V p—p, troubleshoot the output amplifier; if not, troubleshoot the squaring circuit.
11. Output continuous when the instrument is in the trigger/gate mode.	11. Trigger/gate circuit or lock-up amplifier inoperative.	11. Check TP5 for presence of trigger pulse. If absent, troubleshoot trigger/gate circuit. If present, troubleshoot the lock-up amplifier.

SECTION V

THEORY OF OPERATION

5.1 GENERAL DESCRIPTION

Refer to Block Diagram 41000 - 224 for the following explanation. Bridge diodes and R1 and R2 reference designations are assigned to facilitate the discussion.

The Model 410 consists of a main generator and a sweep generator. The main generator develops the sine, square and triangle waveforms. The sweep generator develops the ramp waveform and also sweeps the frequency range selected in the main generator.

Frequency dial potentiometer, R819, establishes the level of frequency control voltage at the outputs of amplifiers Z104 and Z106. These two control voltages determine the currents that flow through R1 and R2 to charge and discharge the integrating capacitor. The amount of charging current and the size of integrating capacitor selected determine the output frequency of the main generator.

The triangle and square waveforms are simultaneously developed in the main generator. The linear charging and discharging of the integrating capacitor develop the triangle, which is level-detected by the comparator to develop the square waveform. The comparator output is connected to the junction of bridge diodes CR3 and CR4 and this alternating step voltage is used to steer the charging current to the integrating capacitor.

When the comparator output is negative, CR4 is forward biased and the current through R1 is diverted from the integrating capacitor. Diode CR3 is then reverse biased and the integrating capacitor charges negatively through R2, causing the voltage at the output of the integrator to go positive at a constant rate. When the upper hysteresis point of the comparator is reached by this positive-going voltage, the state of the comparator changes making the junction of CR3 and CR4 positive. The current through R1 then charges the integrating capacitor positively, causing the voltage at the output of the integrator to go negative at a constant rate. When the voltage reaches the lower hysteresis point of the comparator, the state of the comparator changes, making the junction of CR3 and CR4 negative. The time required to charge and discharge the integrating capacitor determines the period of one cycle and therefore the frequency.

The comparator output is also applied to the squaring circuit which utilized complementary differential pairs and stable positive and negative voltage sources to develop an amplified, symmetrical square waveform. A signal of equal amplitude and a 180^{o} phase shift from the square wave output is coupled back to the inverting input of the comparator to establish its hysteresis points.

The sine waveform is developed by shaping the triangle which results in a sine wave of reduced amplitude. A non-inverting amplifier restores the amplitude of the sine wave to that of the applied triangle.

When the instrument is in the trigger or gate mode, the trigger or gate logic circuitry diverts the charging sources from the integrating capacitor. The application of a trigger or gate signal allows the integrating capacitor to charge for the duration of the signal.

The sweep generator output is a linear ramp voltage which is developed by an active integrator and

a comparator similar to those in the main generator. However, the integrating capacitor is allowed to charge only in a positive direction. The time required to charge the integrating capacitor determines the sweep duration and therefore the sweep repetition rate. The duration potentiometer R823 controls the amount of current to the integrating capacitor and functions as a continuous adjustment within the range selected by the duration switch. In the triggered sweep mode the charging current is diverted from the integrating capacitor until the trigger signal is applied.

The amplitude modulation circuit provides for the modulation of the sine, square, triangle and ramp waveforms by an external signal. The heart of the AM circuit is the four-quadrant multiplier which accomplishes the modulation and whose output is the linear product of its two inputs. The multiplier output is amplified by a non-inverting amplifier then fed to the Channel A and B waveform switches and to a front panel connector as the AM OUTPUT.

Frequency modulation is accomplished by applying an external voltage to the FM INPUT. This external voltage is summed with the voltage from the frequency dial potentiometer R819 at the input of amplifier Z103. The change in voltage changes the charging rate of the integrating capacitor which changes the output frequency.

Channel A and B output amplifiers provide final amplification of all output signals.

5.2 DETAILED CIRCUIT DESCRIPTION

5.2.1 Main Generator

Refer to schematic 40000 - 402, Functional Block Diagram, 41000 - 226 and the applicable simplified schematic for the circuit descriptions in paragraph 5.2.1.1 through 5.2.1.6.

5.2.1.1 Frequency Control

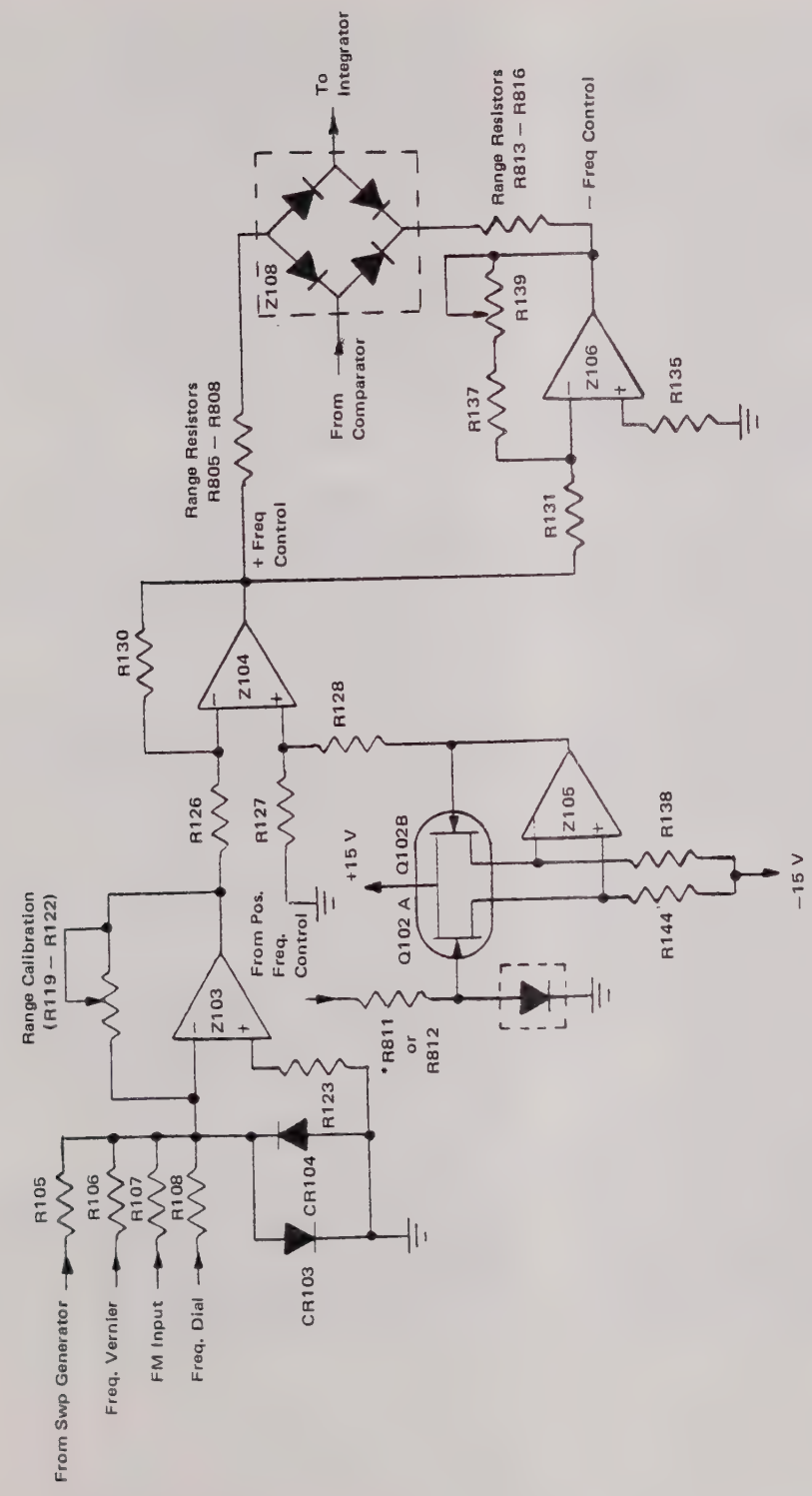
Refer to Figure 5 - 1 for the following explanation.

Frequency in the Model 410 is controlled by applying variable positive and negative voltage levels to the range resistors (R805—R809 and R813—R816) and using the resulting current to charge the integrating capacitor (C801 through C810).

The frequency control circuit supplies the voltage levels to the range resistors. Voltages from the frequency dial potentiometer, R824, FM input and/or the sweep generator are summed at the inverting input of operational amplifier Z103. The output of Z103 is coupled to the inverting input of the positive frequency control voltage source Z104, whose output is coupled to the inverting input of the negative frequency control voltage source Z106. Dual FET Q102A/B and Z105 comprise a network to compensate for the 0.6 volt drop across the bridge diode at low integrating currents (X0.01 and X1 ranges). The output of Z105 make the non-inverting input of Z104 approximately 0.6 volts thus increasing the output of Z104 by about 0.6 volts.

The currents developed by the voltage sources and the range resistors are alternately switched to the integrator by the alternating step voltage (comparator output) at the junction of terminals 5 and 11 of Z108. When the step voltage is positive, the diode across terminals 11 and 12 is reverse biased and the integrating capacitor charges positively. When the step voltage is negative, the diode across terminals 5 and 6 is reverse biased and the integrating capacitor charges negatively.

Potentiometers R119 through R122 are gain adjustments for amplifier Z103 on the 2 Hz to 2 kHz ranges respectively. Diodes CR103 and CR104 are for input overvoltage protection and diodes CR108 and CR109 establish a threshold to prevent the bridge from being switched on by spurious signals.



Dotted Lines Indicate Diode Array Z108

* In the circuit only on the .01 or X 1 ranges.

Figure 5 - 1. Frequency Control

5.2.1.2 Integrator

The integrator consists of an integrating amplifier and integrating capacitor (C801 through C810). The integrating amplifier is actually two separate amplifiers, one a dc amplifier which is active at the lower frequencies and the other an ac amplifier which takes over at the higher frequencies. Dual FET Q105A/B is the input for the dc amplifier and differential amplifier Q108/Q109 is the input for the ac section. The RC network consisting of C112 and R157 determines the frequency where the shift from the dc to ac amplifier takes place. Capacitors C114 and C116 are roll-off capacitors and potentiometer R152 is the integrator balance which adjust the symmetry of the waveform at the low integrating currents (the low end of the frequency dial). Essentially, the integrating amplifiers is a high gain amplifier whose input draws practically no current. The summing point (between R150 and C112) is held at 0 volts through the feedback path provided by the integrating capacitor (C801 through C810). The amount of current flowing out of or into the amplifier output is determined by the level of the frequency control voltages. Charging and discharging the integrating capacitor develops the triangle waveform.

5.2.1.3 Comparator

The comparator simultaneously level-detects the triangle wave to develop the square wave, compares the amplitude of the triangle and square wave and supplies the alternating step voltage to switch the frequency control bridge.

The inputs to the comparator are the integrator output and the 180^{o} square wave output (see paragraph 5.2.1.4). Resistors R194, R195, R197 and R203 form voltage dividers which limit the input voltages to the comparator. The square wave input to pin 4 of Z109 sets the hysteresis points of the comparator (the points where the comparator output shifts levels) at approximately +1.7 and -1.7 volts.

The output of Z109 is an alternating step voltage of approximately 3.4 volts peak-to-peak (0.35 to +3.05 volts). The baseline of the step voltage is shifted down approximately 1.2 volts by the junction of Q116 and CR121, causing the voltage at the cathode of CR121 to step from -1.6 to +1.6 volts. This step voltage is fed to the frequency control bridge and to the input of the squaring circuit. Capacitors C126 and C127 compensate for the comparator switching time at high frequencies, thus insuring a constant triangle amplitude over the entire frequency range. Emitter follower, Q116 is used for impedance matching.

5.2.1.4 Squaring Circuit

The squaring circuit has two 10 volt peak-to-peak outputs. One output is in phase with the input and the other is 180^{o} out of phase. The 180^{o} output is coupled back to the inverting input of the comparator and the in-phase output is fed to the waveform and AM switches.

The squaring circuit consists of two complementary differential pairs Q119/Q121 and Q120/Q122 which drive complementary output pairs Q116/Q118 and Q123/Q124. The alternating step voltage at the bases of Q119 and Q120 simultaneously turns one transistor on and the other off. Assuming that the step voltage is positive, Q119 is on and Q120 is off, consequently Q121 is off and Q122 is on. With Q119 and Q122 conducting Q118 and Q123 are turned on, causing the collector of Q118 to swing to -5 volts and the collector of Q123 to swing to +5 volts. When the step voltage at the base of Q119 and Q120 is negative the conducting and non-conducting states of the transistors are reversed and the collector of Q116 swings to +5 volts, while the collector of Q124 swings to -5 volts.

Clamp diodes CR122 through CR125 provide over-voltage protection for the bases of output transistors, Q117, Q118, Q123 and Q124. Capacitors C134 and C135 are bypass capacitors and C136 is a roll-off capacitor. Operational amplifiers Z110 and

Z111 provide stable positive and negative 5 volt sources for the output transistors. Potentiometers R230 and R232 are gain adjustments for the amplifiers. Resistors R221 and R222 divide the 10 volt peak-to-peak square wave output.

5.2.1.5 Trigger/Gate Circuit

The trigger/gate circuit consists of differential comparator Z101 and logic circuits Z102 and Z107. This circuit enables the lock-up amplifier which disables the integrator when the instrument is in the trigger or gate mode. Applying a trigger or gate signal disables the lock-up amplifier and enables the integrator.

When the trigger mode is selected, ground is applied through the mode switch to pin 10 of Z107. Assuming that positive slope triggering is selected, the output at pin 8 will be +3 volts. This voltage is applied to the reset input (pin 1) of Z102 and its output (+3 volts) enables the lock-up amplifier. The positive slope of a trigger pulse changes the output at pin 6 of Z102 to 0 volts and the lock-up amplifier is disabled. The comparator output at the base of Q101 insures that the instrument is triggered at the beginning of the waveform.

5.2.1.6 Lock-Up Amplifier

Refer to Figure 5-2 for the following explanation.

The lock-up amplifier by forward-biasing CR110, diverts the charging current from the integrating capacitor when the instrument is in the trigger or gate mode.

During normal operation when the main generator is free running, +15 volts is applied by the mode switch (normal position) to resistor, R198. This voltage forward biases CR119 and reduces the base current to Q113 below the level needed to keep it turned on. With Q113 not conducting, Q104 is off and CR110 is reverse biased.

In the trigger or gate mode, the +3 volt output of Z102 to the cathode of CR118 turns Q113 and Q104 on and forward biases CR110. When the external trigger is applied, Q113 and Q104 are turned off and C110 is reverse biased thus allowing current to flow to the integrating capacitor.

5.2.2 Sine Converter

Refer to schematic 40000 - 404 for the following explanation.

The sine converter is comprised of a sine shaper and a sine amplifier. Its function is to convert the 10 volts peak-to-peak triangle into a 10 volt peak-to-peak sine wave.

The triangle is shaped into 6 volts peak-to-peak sine wave by the sine shaper. Operational amplifiers Z301 and Z302 are voltage sources for the sine shapers. Potentiometers R302 and R305 are gain adjustments for amplifier Z301 and Z302.

The sine amplifier, consisting of Z304 and transistors Q301 through Q304, has a differential input and a push-pull output. The sine amplifier gain is approximately 1.67 therefore the 6 volt peak-to-peak sine wave is amplified to 10 volts. Diodes CR301 and CR302 establish the bias for output transistors Q303 and Q304 and resistors R322 and R323 and feedback resistors for amplifier gain control. Capacitors C309 through C311 and resistors R324, R327 and R328 comprise a 10 kHz notch filter which is used during sine distortion calibration.

5.2.3 Sweep Generator

Refer to the simplified schematic 40000 - 403 and Functional Block Diagram 41000 - 226 for the following explanation.

The operation of the sweep generator is similar to the main generator with the exception that the sweep integrating capacitor (C812 through C817 on the duration switch) is allowed to charge only in

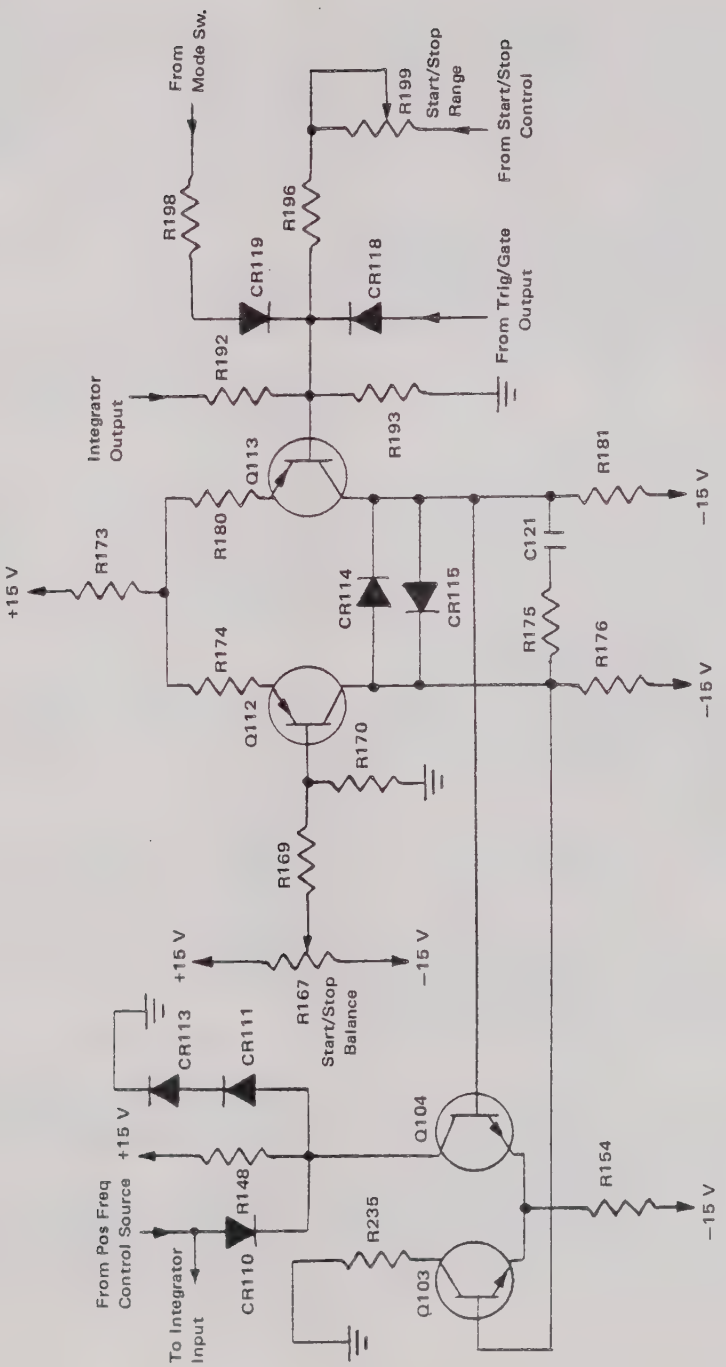


Figure 5 - 2. Lock-Up Amplifier

the positive direction. After the capacitor has charged to approximately 10 volts, the output of comparator Z703, taken at the collector of Q712, resets trigger logic R/S flip-flop Z702. The output of Z702 forward biases Q701 and CR708 and the integrating current is diverted through Q701. Transistor Q702 is turned on by the positive-going collector of Q701 and a quick discharge path for the integrating capacitor is provided.

When the sweep mode switch is in the triggered position, the output of Z702 is approximately +3 volts. Diode CR708 and transistor Q701 are forward biased by this voltage and they conduct, diverting the current from the integrating capacitor. An external trigger pulse applied to the input of Z701 changes the output state of Z702 to approximately 0 volts. Diode CR708 is then reverse biased and current flows to the integrating capacitor for the duration of the trigger pulse.

5.2.4 Amplitude Modulation

Refer to schematic 40000 - 405 for the following explanation.

Amplitude modulation is accomplished in the four-quadrant multiplier, Z401. Both the modulating signal and the signal to be modulated are the inputs to Z401. The output of the four-quadrant multiplier is the linear product of the two input voltages multiplied by a factor of 0.1. For example, if the modulating signal is 2 volts and the signal to be modulated is 10 volts, the output of the four-quadrant multiplier is 2 volts.

The modulated signal is amplified by Z402 and coupled to differential amplifier, Q401/Q402 which drive complementary emitter followers Q403 and Q404. The AM output signal is fed to Channel A and B waveform switches, and divided by R445 and R446 and coupled to a front panel connector at the AM output.

Diodes CR401 and CR402 provide input over-voltage protection for the four-quadrant multiplier. Diodes CR403 and CR404 establish the bias levels for the output emitter followers. Feedback for the amplifier is taken through the RC network consisting of C410 through C412 and resistors R428 and R430 through R434.

5.2.5 Output Amplifier

Refer to schematic 40000 - 406 for the following explanation.

The Model 410 has two independent output amplifiers. Since the operation of the two amplifiers are identical, only Channel A output will be explained.

The output amplifier has a gain of 4 and provides final amplification for all of the output waveforms. Offset is supplied at the amplifier summing point (the junction of R602, R603 and R604) by offset control R833.

The input stage of the output amplifier consists of complementary differential pairs, Q601/Q604 and Q602/Q605. These differential amplifiers alternately supply emitter current to amplifiers Q603 and Q604 which in turn supply base current to drivers Q607 and Q608. Emitter follower Q609 and Q610 drive parallel complementary emitter followers Q611 through Q614.

Diodes CR601 through CR604 establish the bias levels for transistors Q607 and Q608. The overall amplifier gain is controlled through the feedback network consisting of R605 through R612 and C606 through C609. Capacitors C606 and C607 are high frequency compensation adjustments.

5.2.6 Power Supply

Refer to schematic 40000 - 401 for the following explanation.

The power supply consists of four series regulators; positive and negative 30 volts and positive and negative 15 volts. The positive and negative 30 volt regulator are identical with the exception that

the +30 volt regulator is referenced to the +15 volt supply and the -30 volt regulator is referenced to the +30 volt supply. Both 15 volt regulators are identical with the exception that the +15 volt regulator is referenced by zener diode CR17 and the -15 volt regulator is referenced through R39 to the +15 volt supply. Basically, the operation of the four regulators are the same, therefore only the +30 volt regulator will be explained.

Any error between the reference voltage and the voltage at the junction of R43 and R44 is amplified by Z3. This amplified error signal causes a change in current through the high gain series pass transistors (Q5 and Q6) to correct for the error.

Over-current protection is provided by transistors Q1 and Q11. During normal operation, both transistors are off. However when an over-current condition occurs, Q11 is forward biased by the voltage drop across diode CR15 and parallel resistors R34 and R35. This causes Q11 to conduct and the excess current is shunted around series pass transistors Q5 and Q6.

CHAPTER 6

PARTS LIST

6.1 INTRODUCTION

This chapter contains the parts lists for each assembly in the Model 410 Sweep Function Generator. Chapter 7 shows the assemblies where the listed parts are installed. Ordering information is included and should be used when purchasing parts from the factory. Explanation of the column listings and Table 6 - 1 Manufacturer's Code- To- Name Index are also included.

6.2 PART ORDERING INFORMATION

To order a part from the Replaceable Parts List, state the Systron Donner part number, indicate the quantity required and address the order to the nearest Systron Donner Sales or Service Center.

To order a part not listed in the Replaceable Parts List, state the instrument model number, instrument serial number, the description and function of the part and the number of parts required. Address the order to the nearest Systron Donner Sales or Service Center.

6.3 PARTS LIST

The replaceable parts lists are placed in A numbered sequence. Each column in the parts lists provide specific information relating to the listed parts as follows:

(1) **DESIGNATOR:** Reference numbers applicable to assemblies are listed in alpha numeric order.

(2) **COMPONENT NOMENCLATURE AND DESCRIPTION:** Component names and specifications are provided in these columns and include value, tolerance, wattage rating, working voltage, construction, etc.

(3) **MANUFACTURER'S CODE:** H4-2 Federal Supply Code numbers are listed to identify component manufacturers. A Manufacturers Index is provided in this chapter for cross-reference.

(4) **MANUFACTURER'S PART NUMBER:** True manufacturer part numbers are listed in this column.

(5) **SD STOCK NUMBER:** The Systron Donner stock number is listed in this column.

(6) **T/Q** (Total Quantity): This quantity, appearing after an item entry, indicates the number of times the component is used in that assembly. The total quantity for each part is given only once - at the first appearance of the part number in the list.

TABLE 6-1 MANUFACTURER'S CODE-TO-NAME INDEX

Code	Name & Address
00853	Sangamo Electric Co. So. Carolina Div. P.O. Box 128 Pickens, SC 29671
01121	Allen Bradley Co. 1201 S. 2nd Street Milwaukee, WI 53204
02735	RCA Corporation Solid State Division Route 202 Somerville, NJ 08876
02799	Arco Electronics 2725 Columbia Street Torrance, CA 90501
04713	Motorola Semiconductor Products Inc. 5005 E. McDowell Road Phoenix, AZ 85008
05820	Wakefield Engineering, Inc. Audobon Road Wakefield, MA 01880
06540	Amatom Electronic Hardware Division of Mite Corp. 81 Rockdale Ave. New Rochelle, NY 10806
07047	Ross Milton Co. 511 Second St. Pike Southampton, PA 18966
07263	Fairchild Camera & Instrument Corp. Semiconductor Division 313 Frontage Road Mountain View, CA 94040
08289	Blinn Delbert Co. Inc. P.O. Box 2007 1678 Mission Blvd. Pomona, CA 91766
09353	C and K Components Inc. 103 Morse Newton, MA 02158
11534	Duncan Electronics Inc. 2865 Fairview Rd. Costa Mesa, CA 92626
14298	American Components Inc. RPC Division 8th Avenue at Harry St. Conshohocken, PA 19428
16299	Corning Glass Works Electronic Components Division 3900 Electronics Drive Raleigh, NC 27604
16758	Delco Radio Kokomo, IN
19701	Mepco/Electra Inc. Electra Division P.O. Box 760 Mineral Wells, TX 76067
27556	IMB Electronic Prod. Inc. 15401-E Carmenita Rd. Santa Fe Springs, CA 90670
52542	Systron Donner Corp. Instrument Division 2727 Systron Drive Concord, CA 94518
59730	Thomas & Betts Co. 36 Butler St. Elizabeth, NJ 07207
71400	Bussmann Mfg. Division of McGraw-Edison Co. 2536 W. University St. St. Louis, MO 63017
71590	Globe - Union Inc. Centralab Electronics Division 5757 No. Green Bay Ave. Milwaukee, WI 53201
72136	Electro Motive Mfg. Co. Inc. South Park & John Street Willimantic, CT 06226
75915	Littlefuse Inc. 800 E. Northwest Hwy Des Plaines, IL 60016
76545	Mueller Electric Co. 1583 E. 31st St. Cleveland, OH 44114

TABLE 6-1 MANUFACTURER'S CODE-TO-NAME INDEX (Cont'd)

Code	Name & Address	Code	Name & Address
78189	Illinois Tool Works Inc. Shakeproof Division St. Charles Rd. Elgin, IL 60120	88245	Litton Systems Inc. USECO Division 13536 Saticoy St. Van Nuys, CA 91409
79963	Zierick Mfg. Co. Radio Circle Mt. Kisco, NY 10549	91637	Dale Electronics Inc. P.O. Box 609 Columbus, NB 68601
81349	MIL STD	95987	Weckesser Co. Inc. 4444 W. Irving Park Rd. Chicago, IL 60641
82389	Switchcraft Inc. 5555 N. Elston Ave. Chicago, Il 60630	96733	San Fernando Electric Mfg. Co. 1509 First St. San Fernando, CA 91341
86928	Seastrom Mfg. Co. Inc. 701 Sonora Ave. Glendale, CA 91201	96906	MIL STD

TITLE FRONT PANEL ASSEMBLY #37000-901 Rev J

ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	C811	CAPACITOR, DM 100 pF 5%, 500V	72136	DM10FD101JO	100252	1
	C819	CAPACITOR, DM 22 pF 5%, 500V	72136	DM15ED220JO	100068	1
	J801	CONNECTOR, BNC	81349	UG-1094/U	101155	2
	J809	Same as J801				
	R123	RESISTOR, CC 12 k 5%, 1/4W	01121	CB1235	101565	1
	R801	RESISTOR, Variable 10 k 10%, 2W	01121	JJC96098	112096	2
	R802	Same as R801				
	R804	RESISTOR, CC 1 M 5%, 1/4W	01121	CB1055	101605	2
	R817	RESISTOR, CC 56 Ω 5%, 1/4W	01121	CB5605	101735	1
	R818	Same as R804				
	R819	RESISTOR, Variable 1 K 5%, 1/4 W	11534	1630–798	106098	1
	R832	RESISTOR, CC 150 k 5%, 1/4W	01121	CB1545	101604	2
	R839	RESISTOR, Variable 500 Ω 10%, 2W	01121	JAIN0565501AA	112066	2
	R840	RESISTOR, CC 2 Ω 5%, 1/2W	01121	EB20G5	106010	2
	R841	RESISTOR, MF 550 Ω 1%, 1/4W	81349	RN60D5490F	106325	2
	R842	RESISTOR, MF 4.99 k 1%, 1/4 W	91637	MFF 1/8 T1	102079	2
	R843	RESISTOR, MF 49.9 Ω 1%, 1/4W	81349	NA60	106249	2
	R844	Same as R832				
	R851	Same as R839				
	R852	Same as R840				
	R854	Same as R842				
	R855	Same as R843				
	R853	Same as R841				
	S1	SWITCH, Power Toggle	09353	7101	102310	1
	S802	SWITCH, SPDT Non-Locking	82389	903-1C-RED	106794	2
	S805	Same as S802				

TITLE FRONT PANEL ASSEMBLY #37000-901 (Cont'd)

ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
		SCREW, PHMS 8-32 x 5/8	96906	MS24693-C51	10074310	16
		TRIM, Front	52542	32001-203	32001-203	2
		TRIM, Front End	52542	32001-213	32001-213	2
		NUT, Speed 6-32			100959	8
		SCREW, FHMS 6-32 x 1/4	96906	MS24693-C24	10073104	8
		NUT, Kep 6-32	78189	511-061800-01	112472	2
		INDICATOR, Green		BFA-14-GRN	106900	1
		PLATE, Face	52542	32001-150	32001-150	1
		PANEL, Front	52542	32001-139	32001-139	1
		LUG, Solder	79963	334-375	112551	10
		BRACKET	52542	32001-141	32001-141	2

TITLE FREQUENCY RANGE SWITCH ASSEMBLY #37000-896 Rev D

ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	C801	CAPACITOR, Variable 1.5 - 20 pF, 175 V	02799	402	106504	2
	C802	CAPACITOR, MM 39 pF 5%, 500V	00853	DR1439	106383	2
	C803	Same as C801				
	C804	Same as C802				
	C805	CAPACITOR, Variable 3-30 pF, 175V	02799	403	106506	1
	C806	CAPACITOR, DP Ceramic 470 pF 1%, 300V	96733	DB45BY471J	117637	1
	C807	CAPACITOR, Mylar .005 μF 2%, 200V	27556	BA2C502G	106477	1
	C808	CAPACITOR, Mylar .05 μF 2%, 200V	07994	MPW2503G	106478	1
	C809	CAPACITOR, Mylar .5 μF 5%, 200V	27556	BA2C504G	106479	1
	C810	CAPACITOR, Mylar 5 μF 5%, 200V	27556	BA2173	106476	1
	R803	RESISTOR, Variable 10 k 10%, 2W	01121	JAIN056S103UA	112074	1
	R805	RESISTOR, Variable 4.99 k 1%, 1/8W			102079	2
	R806	RESISTOR, MF 50 k .1%, 1/8W	14298	RN60C	106356	2
	R807	RESISTOR, MF 500 k .1%, 1/8W	14298	RN60C	106357	2
	R808	RESISTOR, MF 4.99 M 1%, 1/8W	91637	DC-1/4	106158	2
	R813	Same as R805				
	R814	Same as R806				
	R815	Same as R807				
	R816	Same as R808				
	S803	SWITCH, Rotary	52542	112030	112030	1
		SPACER 6-32 x 7/8	06540	8160-PH-0632	106949	1
		BOLT, Spade 6-32 x 3/4			112348	1

REPLACEABLE PARTS LIST

TITLE	SWEEP DURATION SWITCH ASSEMBLY #37000-892 Rev D					
ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	C812	CAPACITOR, Variable 1.5 - 20 pF	02799	402	106504	1
	C813	CAPACITOR, DM 82 pF 5%, 500V	72136	DM15ED820JO	100172	1
	C814	CAPACITOR, DM .001 μF 5%, 500V			100146	1
	C815	CAPACITOR, Mylar .01 μF 1%, 300V	27556	ZA2D103F	112557	1
	C816	CAPACITOR, Mylar .1 μF 1%, 200V	14752	210B1C104F	106421	1
	C817	CAPACITOR, Mylar 1 μF 1%, 200V	14752	210B1C105F	106422	1
	C818	CAPACITOR, Ceramic .022 μF 20%, 25V	71590	2DDU60E223M	106483	1
	R820	RESISTOR, CC 1 k 5%, 1/4W	01121	CB1025	101569	1
	R821	RESISTOR, CC 1.3 M 5%, 1/4W	01121	CB1355	106000	1
	R822	RESISTOR, CC 13 M 5%, 1/4W	01121		112473	1
	R823	RESISTOR, Variable 10 k 10%, 2W	01121	JAIN056S103UA	112074	1
	S807	SWITCH, Sweep Duration	52542	112232	112232	1

REPLACEABLE PARTS LIST

TITLE: SWEEP WIDTH SWITCH ASSEMBLY #37000-893 Rev E

ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	R824	RESISTOR, Variable 10 K 1%, 2W	01121	JAIN056S103UA	112074	1
	R825	RESISTOR, MF 90 k 1%, 1/4W	81349	RN60D9002E	106327	1
	R826	RESISTOR, MF 909 k 1%, 1/8W	19701	MF5C-D-9093-F	102159	1
	S808	SWITCH, Sweep Width	52542	112231	112231	1

REPLACEABLE PARTS LIST

TITLE: AM WAVEFORM SWITCH ASSEMBLY #37000-894 Rev C

ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	R827 thru R830	RESISTOR, CC 330 Ω 5%, 1/4W	01121	CB3315	101536	4
	R831	RESISTOR, Variable 10 k 10%, 2W	01121	JAIN056S103UA	112074	1
	S809	SWITCH, Rotary 5-pos	52542	112259	112259	1

TITLE WAVEFORM SELECT SWITCH ASSEMBLY #37000-895 Rev B

ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
		CHANNEL A				
	R833	RESISTOR, Variable 10 k 10%, 2W	01121	JAIN0565S103UA	112074	1
	R834 thru R838	RESISTOR, CC 330 Ω 5%, 1/4W	01121	CB3315	101536	5
	S811	SWITCH, Rotary 5-pos	52542	112257	112257	1
		CHANNEL B				
	R845	RESISTOR, Variable 10 k 10%, 2W	01121	JAIN056S103UA	112074	1
	R846 thru R850	RESISTOR, CC 330 Ω 5%, 1/4W	01121	CB3315	101536	5
	S814	SWITCH, Rotary 5-pos	52542	112257	112257	1

REPLACEABLE PARTS LIST

TITLE **REAR PANEL ASSEMBLY #37000-899 Rev C**

ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	F1	FUSE, Slo-Blo 1 A	71400	MOL-1	106909	1
	Q3	TRANSISTOR, SINPN 30W	04713	2N4921	101386	1
	Q4	TRANSISTOR, SIPNP 30W	04713	2N4918	101387	1
	Q5	TRANSISTOR, SIPNP 60V	04713	MJE2955	106583	1
	Q8	TRANSISTOR, SINPN 60V	04713	MJE3055	106602	1
	S2	SWITCH, Slide	82389	46256LFR	102331	1
	T1	TRANSFORMER, Power	52542	112170	112170	1
		CLAMP, Cable	59730	TC-104	112574	3
		HOLDER, Fuse	75915	345002	117381	1
		HEATSINK	52542	106962	106962	1
		RELIEF, Strain		SR-5P-1	106967	1
		BOLT, Spade			112349	2
		SCREW, PHMS 4-40 x 1/2	96906	MS51957-17	10062608	4
		COMPOUND, Thermal	05820	120-8	100750	A/R
		WASHER, Cprsn	04713	B52200F003	103351	4
		WASHER, Mica	08289	SK-73-48-13	103352	4
		NUT, Kep 6-32	78189	511-041800-00	100941	2
		LINE CORD		C2112-008-8L	112008	1
		WASHER, Internal Tooth #8	96906	MS35333-72	100687	4
		SCREW, PHMS 6-32 x 1/2	96906	MS51957-30	10063208	1
		PANEL, Rear	52542	32001-463	32001-463	1
		WASHER, Internal Tooth #6	96906	MS35333-71	100647	1
		SCREW, PHMS 8-32 x 2-1/4	96906	By Description	112650	4
		WASHER, Flat #8	96906	MS15795-807	100705	4
		NUT, Cap 8-32	96906	By Description	112272	4

TITLE PC BOARD ASSEMBLY #37000-928 Rev P_2

ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	C1	CAPACITOR, El Can 4000 µF, 50V	99392	23C50HA43	106463	2
	C2	Same as C1				
	C3	CAPACITOR, El Can 3500 µF, 25V	99392	23C25TA352	106458	2
	C4	Same as C3				
	C5	CAPACITOR, Ceramic .022 µF 20%, 25V	71590	2DDU60E223M	106483	65
	C6	Same as C5				
	C7	CAPACITOR, Tant 22 µF 20%, 25V	31433	1362C226M025AS	112281	14
	C8	Same as C7				
	C9	CAPACITOR, El Can 100 µF -10-100%, 35V	29309	MC-5A-100-35-8P	106460	6
	C10	Same as C9				
	C101	CAPACITOR, DP Ceramic 100 pF 5%, 100V	96733	DB44BY101J	117628	3
	C102	Same as C5				
	C103	Same as C5				
	C104	CAPACITOR, DP Ceramic 5 pF 5%, 100V	71590	CN10A4R70	117358	7
	C105 thru C108	Same as C5				
	C109	CAPACITOR, DP Ceramic 220 pF 5%, 100V	96733	DB44BY221J	117633	3
	C110	Same as C5				
	C111	Same as C5				
	C112	CAPACITOR, DP Ceramic 1000 pF 10%, 100V	04222	3418100C102K	117568	4
	C113	CAPACITOR, DP Ceramic 68 pF 5%, 100V	96733	DB44BY680J	117626	2
	C114	Same as C112				
	C115 thru C120	Same as C5				
	C121	CAPACITOR, DP Ceramic 22 pF 5%, 100V	96733	DB44BY220J	117641	5
	C122	Same as C7				

TITLE PC BOARD ASSEMBLY #37000-928 (Cont'd)

ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	C123	Same as C5				
	C124	Same as C5				
	C125	Same as C7				
	C126	CAPACITOR, Variable 15-60 pF	72982	538-011F15-60	100234	1
	C127	CAPACITOR, DP Ceramic 47 pF 5%, 100V	96733	DB44BY470J	117359	5
	C128	Same as C113				
	C129	Same as C5				
	C130	CAPACITOR, DP Ceramic 10 pF 5%, 100V	96733	DB44BY100J	117621	6
	C131 thru C135	Same as C5				
	C136	CAPACITOR, DP Ceramic 33 pF 5%, 100V	71590	CN15A330K	117471	3
	C137	Same as C5				
	C138	Same as C5				
	C139	Same as C7				
	C140	Same as C7				
	C141 thru C143	Same as C130				
	C144	CAPACITOR, Ceramic .1 μF -180-30%, 75V	71590	DDA104	106485	25
	C145	Same as C121				
	C146	CAPACITOR, DP Ceramic 15 pF 5%, 100V	96733	DB44BY150J	117624	2
	C301	Same as C5				
	C302	Same as C5				
	C303	Same as C7				
	C304	Same as C7				
	C305	Same as C5				
	C306	Same as C5				
	C307	CAPACITOR, DM 1000 pF 1%, 100V	02799	DM15-102F	106406	4
	C308	Same as C121				
	C309	CAPACITOR, DM 500 pF 1%, 500V	02799	DM15-501F	106408	2

TITLE PC BOARD ASSEMBLY #37000-928 (Cont'd)

ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	C310	Same as C307				
	C311	Same as C309				
	C312	Same as C127				
	C313	Same as C5				
	C314	Same as C5				
	C315	Same as C7				
	C316	Same as C7				
	C317 thru C319	Same as C127				
	C401	Same as C5				
	C402	Not Used				
	C403	Not Used				
	C404 thru C408	Same as C5				
	C409	Same as C307				
	C410	Same as C130				
	C411	Same as C104				
	C412	Same as C146				
	C413	Same as C5				
	C414	Same as C7				
	C415	Same as C5				
	C416	Same as C7				
	C501	Same as C5				
	C502 thru C505	Same as C144				
	C506	CAPACITOR, Variable 2.5-11 pF 200V	72982	538-014-908	106499	4
	C507	Same as C506				
	C508	Same as C121				
	C509	Same as C136				
	C510	Same as C5				
	C511	Same as C144				
	C512	Same as C104				
	C513	Same as C144				
	C514	Same as C104*				

TITLE PC BOARD ASSEMBLY #37000-928 (Cont'd)

ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/O
	C515 thru C517	Same as C144				
	C518	Not Used				
	C519	Same as C144				
	C520	Same as C9				
	C521	Same as C9				
	C522	Same as C144				
	C523	Same as C5				
	C601	Same as C5				
	C602 thru C605	Same as C144				
	C606	Same as C506				
	C607	Same as C506				
	C608	Same as C121				
	C609	Same as C136				
	C610	Same as C5				
	C611	Same as C144				
	C612	Same as C104				
	C613	Same as C144				
	C614	Same as C104*				
	C615	Same as C144				
	C616	Same as C144				
	C617	Same as C144				
	C618	Not Used				
	C619	Same as C144				
	C620	Same as C9				
	C621	Same as C9				
	C622	Same as C144				
	C623	Same as C5				
	C701	Same as C104				
	C702	Same as C5				
	C703	Same as C5				
	C704	Same as C109				
	C705	Same as C109				

TITLE	PC BOARD ASSEMBLY #37000-928 (Cont'd)					
ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	C706 thru C708	Same as C5				
	C709	Same as C144				
	C710	Same as C5				
	C711	Same as C5				
	C712	Same as C112				
	C713 thru C715	Same as C5				
	C716	Same as C307				
	C717	Same as C5				
	C718	Same as C144				
	C719	Same as C7				
	C720	Same as C5				
	C721	Same as C5				
	C722	Same as C112				
	C723	Same as C5				
	C724	Same as C101				
	C725	Same as C101				
	C726	Same as C5				
	C727	CAPACITOR, DM 39 pF 5%, 500V	72136	DM15ED390JO	102547	1
	C728	Same as C5				
	C729	Same as C13				
	C730 thru C732	Same as C5				
	C733	Same as C7				
	C734	CAPACITOR, DP Ceramic 560 pF 5%, 100V	96733	DB45BY561J	117677	1
	CR1 thru CR8	DIODE, Rectifier 400V	04713	1N5395	100413	12
	CR9	DIODE, Zener 20V	04713	1N968B	100409	2
	CR10	Same as CR9				
	CR11	Same as CR1				
	CR12	Same as CR1				

TITLE PC BOARD ASSEMBLY #37000-928 (Cont'd)

ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	CR13	DIODE, Signal 50V	03508	1N4151	100385	48
	CR14	Same as CR13				
	CR15	Same as CR1				
	CR16	Same as CR1				
	CR17	DIODE, Reference 9V	04713	1N936	106551	1
	CR101 thru CR104	Same as CR13				
	CR105	DIODE, Zener 10V	04713	1N961B	100395	3
	CR106	DIODE, Zener 9.1V	04713	1N4739A	100425	4
	CR107	Same as CR105				
	CR108	Same as CR13				
	CR109	Same as CR13				
	CR110	Not Used				
	CR111	Same as CR13				
	CR112	Not Used				
	CR113 thru CR119	Same as CR13				
	CR120	Same as CR106				
	CR121 thru CR125	Same as CR13				
	CR301	Same as CR13				
	CR302	Same as CR13				
	CR401 thru CR404	Same as CR13				
	CR501	Same as CR13				
	CR502	DIODE, Signal	26466	1N995	106548	4
	CR503	Same as CR502				
	CR504	Same as CR13				
	CR601	Same as CR13				
	CR602	Same as CR502				
	CR603	Same as CR502				
	CR604	Same as CR13				
	CR701	Same as CR13				
	CR702	Same as CR13				

TITLE PC BOARD ASSEMBLY #37000-928 (Cont'd)

ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	CR703	Same as CR106				
	CR704	Same as CR105				
	CR705 thru CR716	Same as CR13				
	CR717	Same as CR106				
	CR718 thru CR720	Same as CR13				
	Q1	TRANSISTOR, SIPNP 60V	04713	MPS-U55	106580	11
	Q2	TRANSISTOR, SINPN 60V	04713	MPS-U05	106597	12
	Q3 thru Q5	Not Used				
	Q6	Same as Q1				
	Q7	Same as Q2				
	Q8	Not Used				
	Q9	TRANSISTOR, SINPN 25V	04713	MPS6515	106593	10
	Q10	TRANSISTOR, SIPNP 25V	04713	MPS6519	106578	19
	Q11	Same as Q2				
	Q12	Same as Q1				
	Q101	TRANSISTOR, SINPN 15V	52542	112150	112150	11
	Q102	TRANSISTOR, JFET N-Channel 50V	32293	2N3958 q	102727	3
	Q103	Same as Q101				
	Q104	Same as Q101				
	Q105	Same as Q102				
	Q106	TRANSISTOR, SIPNP 40V	04713	2N3906	101378	8
	Q107 thru Q109	Same as Q106				
	Q110	TRANSISTOR, SINPN 12V	02735	2N5179	101388	4
	Q111	Same as Q110				
	Q112	Same as Q10				
	Q113	Same as Q10				
	Q114	Same as Q9				
	Q115	Same as Q106				
	Q116	Same as Q101				
	Q117	TRANSISTOR, SIPNP 12V	07293	PN4258-18	102675	6

TITLE PC BOARD ASSEMBLY #37000-928 (Cont'd)

ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	Q118	Same as Q101				
	Q119	Same as Q101				
	Q120	Same as Q117				
	Q121	Same as Q101				
	Q122	Same as Q117				
	Q123	Same as Q117				
	Q124	Same as Q101				
	Q125	Same as Q10				
	Q126	Same as Q10				
	Q401	Same as Q10				
	Q402	Same as Q10				
	Q403	Same as Q9				
	Q404	Same as Q10				
	Q501	Same as Q9				
	Q502	Same as Q10				
	Q503	Same as Q9				
	Q504	Same as Q9				
	Q505	Same as Q10				
	Q506	Same as Q10				
	Q507	Same as Q1				
	Q508	Same as Q2				
	Q509	Same as Q2				
	Q510	Same as Q1				
	Q511	Same as Q2				
	Q512	Same as Q1				
	Q513	Same as Q2				
	Q514	Same as Q1				
	Q601	Same as Q9				
	Q602	Same as Q10				
	Q603	Same as Q9				
	Q604	Same as Q9				
	Q605	Same as Q10				
	Q606	Same as Q10				
	Q607	Same as Q1				
	Q608	Same as Q2				
	Q609	Same as Q2				

TITLE	PC BOARD ASSEMBLY #37000-928 (Cont'd)					
ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	Q610	Same as Q1				
	Q611	Same as Q2				
	Q612	Same as Q1				
	Q613	Same as Q2				
	Q614	Same as Q1				
	Q701	Same as Q117				
	Q702	TRANSISTOR, JFET N-Channel 25V	04713	2N5555	106612	1
	Q703	Same as Q102				
	Q704 thru Q707	Same as Q10				
	Q708	Same as Q110				
	Q709	Same as Q110				
	Q710	Same as Q2				
	Q711	Same as Q10				
	Q712 thru Q714	Same as Q101				
	Q715	Same as Q117				
	R1	Not Used				
	R2 thru R5	RESISTOR, CC 1 Ω 5%, 1/2W	01121	EB1005	102530	10
	R6	RESISTOR, CC 10 k 5%, 1/4W	01121	CB1035	101570	20
	R7	Same as R6				
	R8	RESISTOR, CC 100 Ω 5%, 1/4W	01121	CB1015	101609	19
	R9	Same as R8				
	R10	RESISTOR, CC 51 Ω 5%, 1/4W	01121	CB5105	101672	5
	R11	Same as R10				
	R12	RESISTOR, CC 1 k 5%, 1/4W	01121	CB1025	101569	28
	R13	Same as R12				
	R14	RESISTOR, CC 390 Ω 5%, 1/4W	01121	CB3915	101592	7
	R15	RESISTOR, CC 6.8 k 5%, 1/4W	01121	CB6825	101544	4

TITLE PC BOARD ASSEMBLY #37000-928 (Cont'd)

ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	R16	Same as R15				
	R17	Same as R14				
	R18	Same as R10				
	R19	Same as R10				
	R20	Same as R2				
	R21	Same as R2				
	R22	Same as R14				
	R23	Same as R6				
	R24	Same as R6				
	R25	Same as R14				
	R26	RESISTOR, CC 5.1 k 5%, 1/4W	01121	CB5125	101541	9
	R27	RESISTOR, CC 820 Ω 5%, 1/4W	01121	CB8215	101567	1
	R28	RESISTOR, MF 10 k 5%, 1/8W	19701	MF5C-D-1002-F	102098	15
	R29	Same as R28				
	R30	RESISTOR, MF 3.57 k 1%, 1/8W	16299	NA60	106242	2
	R31	RESISTOR, Variable 1 k 20%, 1/2W	73138	918	106103	11
	R32	RESISTOR, MF 5.62 k 1%, 1/8W	81349	RN60C5621F	106194	1
	R33	RESISTOR, CC 33 Ωs5%, 1/4W	01121	CB3305	101731	2
	R34 thru R37	RESISTOR, CC 1.5 Ω 5%, 1/2W	01121	EB15G5	112558	4
	R38	Same as R33				
	R39	RESISTOR, MF 30.1 k 1%, 1/8W	81349	RN60D3012F	106318	2
	R40	Same as R28				
	R41	Same as R12				
	R42	Same as R12				
	R43 thru R46	Same as R28				
	R47	Same as R39				
	R48	Same as R28				

TITLE: PC BOARD ASSEMBLY #37000-928 (Cont'd)

ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	R49	RESISTOR, CC 5.6 k 5%, 1/4W	01121	CB5625	101584	2
	R50	RESISTOR, CC 5.6 k 5%, 1/8W	01121	EB5625	101515	1
	R51	Same as R49				
	R52	Same as R12				
	R53	Same as R12				
	R101	Same as R31				
	R102	RESISTOR, CC 10 k 5%, 2W	01121	HB1035	101651	1
	R103	Same as R12				
	R104	RESISTOR, Variable 10 k 20%, 1/2 W	73138	91B	106104	10
	R105	RESISTOR, MF 4.99 k 1%, 1/8W	91637	MFF 1/8 T1	102079	3
	R106	RESISTOR, CC 1.3 M 5%, 1/4W	01121	CB1355	106000	1
	R107	RESISTOR, MF 9.53 k 1%, 1/8W	81349	RN60D9531F	106328	2
	R108	RESISTOR, MF 27.4 k 1%, 1/8W	19701	MF5C-D-2742-F	102100	1
	R109	RESISTOR, CC 2.7 M 5%, 1/4W	01121	CB2755	101621	1
	R110	Same as R6				
	R111	RESISTOR, MF 15 k 1%, 1/8W	19701	MF5C-D-1502-F	101843	1
	R112	Same as R6				
	R113	Same as R6				
	R114	RESISTOR, CC 3.9 k 5%, 1/4W	01121	CB3925	101601	9
	R115	Same as R114				
	R116	RESISTOR, MF 4.53 k 1%, 1/8W	81349	RN60D4531F	106323	1
	R117	Not Used				
	R118	Same as R12				
	R119	Same as R104				
	R120 thru R122	RESISTOR, Variable 2 k 10%, 1/2W	01121	SV2021	106125	5

TITLE PC BOARD ASSEMBLY #37000-928 (Cont'd)

ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	R123	Not Used				
	R124	RESISTOR, CC 560 Ω 5%, 1/4W	01121	CB5615	101583	4
	R125	RESISTOR, CC 68 k 5%, 1/4W	01121	CB6835	101597	1
	R126 thru R128	Same as R28				
	R129	Same as R6				
	R130	Same as R28				
	R131	Same as R28				
	R132 thru R134	Same as R6				
	R135	Same as R26				
	R136	Same as R114				
	R137	Same as R107				
	R138	RESISTOR, CC 82 k 5%, 1/4W	01121	CB8235	101578	2
	R139	Same as R31				
	R140	Same as R114				
	R141	Same as R114				
	R142	Same as R12				
	R143	Same as R114				
	R144	Same as R138				
	R145	RESISTOR, CC 10 Ω 5%, 1/4W	01121	CB1005	101557	14
	R146	Same as R6				
	R147	Same as R6				
	R148	RESISTOR, CC 4.7 k 5%, 1/4W	01121	CB4725	101598	5
	R149	Same as R26				
	R150	RESISTOR, CC 100 k 5%, 1/4W	01121	CB1045	101558	4
	R151	RESISTOR, CC 20 k 5%, 1/4W	01121	CB2035	101607	4
	R152	Same as R104				
	R153	RESISTOR, CC 39 k 5%, 1/4W	01121	CB3935	101561	2

TITLE PC BOARD ASSEMBLY #37000-928 (Cont'd)

ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	R154	Same as R12				
	R155	Same as R151				
	R156	Same as R150				
	R157	RESISTOR, CC 30 k 5%, 1/4W	01121	CB3035	101549	4
	R158	RESISTOR, CC 1.8 k 5%, 1/4W	01121	CB1825	101602	4
	R159	Same as R148				
	R160	RESISTOR, CC 150 Ω 5%, 1/4W	01121	CB1515	101615	4
	R161	RESISTOR, CC 2.7 k 5%, 1/4W	01121	CB2725	101599	4
	R162	RESISTOR, CC 56 Ω 5%, 1/4W	01121	CB5605	101735	5
	R163	RESISTOR, CC 12 Ω 5%, 1/4W	01121	CB1205	101756	3
	R164	Same as R160				
	R165	Same as R162				
	R166	Same as R158				
	R167	Same as R104				
	R168	Same as R157				
	R169	RESISTOR, CC 3.3 k 5%, 1/4W	01121	CB3325	101559	3
	R170	RESISTOR, CC 180 Ω 5%, 1/4W	01121	CB1815	101668	1
	R171	RESISTOR, CC 5.6 Ω 5%, 1/4W	01121	CB56G5	101995	9
	R172	RESISTOR, CC 200 Ω 5%, 1/4W	01121	CB2015	101555	2
	R173	RESISTOR, CC 910 Ω 5%, 1/4W	01121	CB9115	101805	2
	R174	Same as R8				
	R175	Same as R145				
	R176	Same as R12				
	R177	RESISTOR, CC 750 Ω 5%, 1/4W	01121	CB7515	101689	11
	R178	RESISTOR, CC 680 Ω 5%, 1/4W	01121	CB6815	101669	6
	R179	Same as R171				

TITLE	PC BOARD ASSEMBLY #37000-928 (Cont'd)					
ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	R180	Same as R8				
	R181	Same as R12				
	R182	RESISTOR, CC 22 Ω 5%, 1/4W	01121	CB2205	101696	10
	R183	Same as R182				
	R184	RESISTOR, CC 15 Ω 5%, 1/4W	01121	CB1505	101764	9
	R185	Same as R184				
	R186	Same as R182				
	R187	Same as R182				
	R188	RESISTOR, CC 82 Ω 5%, 1/4W	01121	CB8205	101629	1
	R189 thru R191	RESISTOR, MF 499 Ω 1%, 1/8W	16299	NA60	106250	15
	R192	Same as R12				
	R193	RESISTOR, CC 220 Ω 5%, 1/4W	01121	CB2215	101566	6
	R194	Same as R189				
	R195	RESISTOR, MF 100 Ω 1%, 1/8W	91637	MFF 1/8 T1	102086	4
	R196	RESISTOR, CC 3 k 5%, 1/4W	01121	CB3025	101548	7
	R197	Same as R195				
	R198	Same as R12				
	R199	Same as R31				
	R200	Same as R124				
	R201	Same as R145				
	R202	Same as R8				
	R203	Same as R189				
	R204	Same as R8				
	R205	Same as R8				
	R206	RESISTOR, CC 330 Ω 5%, 1/4W	01121	CB3315	101536	6
	R207	RESISTOR, CC 1 k 5%, 1/2W	01121	EB1025	101467	3
	R208	Same as R8				
	R209	RESISTOR, CC 2 k 5%, 1/4W	01121	CB2025	101553	11

TITLE	PC BOARD ASSEMBLY #37000-928 (Cont'd)					
ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	R210	Same as R209				
	R211	Same as R177				
	R212	Same as R177				
	R213	Same as R162				
	R214	Same as R177				
	R215	Same as R177				
	R216	Same as R209				
	R217	Same as R209				
	R218	Same as R8				
	R219	RESISTOR, CC 510 Ω 5%, 1/2W	01121	CB5115	101767	3
	R220	Same as R219				
	R221	Same as R189				
	R222	RESISTOR, MF 56.2 Ω 1%, 1/8W	91637	CMF-60 TI	106324	2
	R223	Same as R161				
	R224	Same as R189				
	R225	Same as R189				
	R226	Same as R189				
	R227	Same as R161				
	R228	Same as R28				
	R229	Same as R31				
	R230	Same as R105				
	R231	Same as R105				
	R232	Same as R31				
	R233	Same as R28				
	R234	Same as R6				
	R235	Same as R8				
	R236	Not Used				
	R237	RESISTOR, CC 1 M 5%, 1/4W	01121	CB1055	101605	3
	R238	Same as R12				
	R301	RESISTOR, CC 22 k 5%, 1/4W	01121	CB2235	101572	3
	R302	Same as R120				
	R303	Same as R148				
	R304	Same as R148				

TITLE	PC BOARD ASSEMBLY #37000-928 (Cont'd)					
ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	R305	Same as R120				
	R306	Same as R301				
	R307	RESISTOR, CC 680 Ω 5%, 1/4W	01121	EB6815	101475	2
	R308	Same as R114				
	R309	Same as R114				
	R310	Same as R307				
	R311	Same as R178				
	R312	Same as R12				
	R313	Same as R184				
	R314	RESISTOR, CC 2.2 k 5%, 1/4W	01121	CB2225	101562	2
	R315	Same as R178				
	R316	Same as R12				
	R317	RESISTOR, CC 7.5 k 5%, 1/4W	01121	CB7525	101596	3
	R318	Same as R206				
	R319	Same as R206				
	R320	Same as R317				
	R321	Same as R314				
	R322	Same as R30				
	R323	RESISTOR, MF 2 k 1%, 1/8W	16299	NA60	106224	1
	R324	RESISTOR, MF 15.8 k 1%, 1/8W	91637	MFF 1/8 TI	102232	1
	R325	RESISTOR, CC 240 Ω 5%, 1/4W	01121	CB2415	101588	2
	R326	RESISTOR, CC 39 Ω 5%, 1/4W	01121	CB3905	101733	1
	R327	RESISTOR, MF 31.6 k 1%, 1/8W	19701	MF5C-D-3162F	102941	2
	R328	Same as R327				
	R329	RESISTOR, CC 1.5 k 5%, 1/4W	01121	CB1525	101577	5
	R330	Same as R182				
	R331	Same as R184				
	R332	Same as R184				
	R333	Same as R182				

TITLE	PC BOARD ASSEMBLY #37000-928 (Cont'd)					
ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	R334	Same as R189				
	R335	Same as R189				
	R336	Same as R189				
	R337	Same as R237				
	R338	Same as R237				
	R401	RESISTOR, CC 5.1 k 5%, 2W	01121	HB5125	106050	1
	R402	RESISTOR, CC 27 k 5%, 1/4W	01121	CB2735	101587	1
	R403	Same as R209				
	R404	Same as R196				
	R405	Same as R206				
	R406	Same as R104				
	R407	Same as R196				
	R408	Same as R209				
	R409	Same as R12				
	R410	Same as R6				
	R411	Same as R12				
	R412	RESISTOR, CC 470 Ω 5%, 1/4W	01121	CB4715	101625	6
	R413	Same as R412				
	R414	Same as R169				
	R415	Same as R169				
	R416	RESISTOR, CC 1.2 k 5%, 1/4W	01121	CB1225	101581	2
	R417	Same as R209				
	R418	Same as R196				
	R419	Same as R31				
	R420	Same as R178				
	R421	Same as R178				
	R422	Same as R209				
	R423	Same as R196				
	R424	Same as R12				
	R425	Same as R317				
	R426	Same as R26				
	R427	Same as R163				

TITLE	PC BOARD ASSEMBLY #37000-928 (Cont'd)					
ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	R428	RESISTOR, CC 510 Ω 5%, 1/4W	01121	CB5115	101616	8
	R429	Same as R26				
	R430	Same as R416				
	R431	Same as R206				
	R432	Same as R31				
	R433	Same as R12				
	R434	Same as R428				
	R435	Same as R325				
	R436	Same as R329				
	R437	Same as R171				
	R438	Same as R171				
	R439	Same as R184				
	R440	Same as R184				
	R441	Same as R171				
	R442	Same as R171				
	R443	Same as R189				
	R444	Same as R189				
	R445	Same as R189				
	R446	Same as R222				
	R501	Same as R104				
	R502	RESISTOR, CC 330 k 5%, 1/4W	01121	CB3345	101658	2
	R503	Same as R196				
	R504	Same as R12				
	R505	Same as R177				
	R506	Same as R177				
	R507	Same as R14				
	R508	RESISTOR, CC 240 Ω 5%, 1W	01121	GB2415	101724	4
	R509	Same as R412				
	R510	Same as R428				
	R511	Same as R508				
	R512	Same as R31				
	R513	Same as R145				
	R514	Same as R145				

TITLE	PC BOARD ASSEMBLY #37000-928 (Cont'd)				
ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	R515	RESISTOR, CC 3.3 k 5%, 1/2W	01121	EB3325	101432	4
	R516	Same as R515				
	R517	Same as R8				
	R518	Same as R145				
	R519	Same as R145				
	R520	Same as R8				
	R521	Same as R428				
	R522	Same as R428				
	R523	Same as R412				
	R524	Same as R145				
	R525	RESISTOR, CC 120 Ω 5%, 1/4W	01121	CB1215	101717	4
	R526	Same as R525				
	R527	Same as R182				
	R528	Same as R193				
	R529	Same as R193				
	R530	Same as R2				
	R531	RESISTOR, CC 10 Ω 5%, 1/2W	01121	EB1005	101632	8
	R532	Same as R531				
	R533	Same as R2				
	R534	Same as R531				
	R535	Same as R531				
	R536	RESISTOR, SNO FM 51 Ω 5%, 2W	16299	C42S	106301	8
	R537	Same as R207				
	R538	Same as R536				
	R539	Not Used				
	R540	Same as R536				
	R541	Same as R536				
	R601	Same as R104				
	R602	Same as R502				
	R603	Same as R196				
	R604	Same as R12				
	R605	Same as R177				
	R606	Same as R177				

TITLE	PC BOARD ASSEMBLY #37000-928 (Cont'd)				
ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	R607	Same as R14				
	R608	Same as R508				
	R609	Same as R412				
	R610	Same as R428				
	R611	Same as R508				
	R612	Same as R31				
	R613	Same as R145				
	R614	Same as R145				
	R615	Same as R515				
	R616	Same as R515				
	R617	Same as R8				
	R618	Same as R145				
	R619	Same as R145				
	R620	Same as R8				
	R621	Same as R428				
	R622	Same as R428				
	R623	Same as R412				
	R624	Same as R145				
	R625	Same as R525				
	R626	Same as R525				
	R627	Same as R182				
	R628	Same as R193				
	R629	Same as R193				
	R630	Same as R2				
	R631	Same as R531				
	R632	Same as R531				
	R633	Same as R2				
	R634	Same as R531				
	R635	Same as R531				
	R636	Same as R536				
	R637	Same as R207				
	R638	Same as R536				
	R639	Same as R209				
	R640	Same as R536				
	R641	Same as R536				
	R642	Same as R178				

TITLE	PC BOARD ASSEMBLY #37000-928 (Cont'd)					
ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	R701	Same as R209				
	R702	RESISTOR, CC 1 k 5%, 1W	01121	GB1025	101635	1
	R703	Same as R6				
	R704	Same as R12				
	R705	RESISTOR, CC 33 k 5%, 1/4W	01121	CB3335	101576	1
	R706	Same as R124				
	R707	Same as R15				
	R708	Same as R12				
	R709	Same as R15				
	R710	Same as R12				
	R711	Same as R6				
	R712	Same as R26				
	R713	Same as R6				
	R714	Same as R26				
	R715	Same as R12				
	R716	Same as R12				
	R717	RESISTOR, CC 15 k 5%, 1/4W	01121	CB1535	101552	2
	R718	Same as R717				
	R719	Same as R145				
	R720	Same as R329				
	R721	RESISTOR, CC 150 k 5%, 1/4W	01121	CB1595	101604	1
	R722	Same as R6				
	R723	Same as R151				
	R724	Same as R150				
	R725	Same as R153				
	R726	Same as R104				
	R727	Same as R151				
	R728	Same as R150				
	R729	Same as R157				
	R730	Same as R158				
	R731	Same as R160				
	R732	Same as R162				
	R733	Same as R161				

TITLE	PC BOARD ASSEMBLY #37000-928 (Cont'd)				
ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	R734	Same as R148				
	R735	Same as R160				
	R736	Same as R162				
	R737	Same as R158				
	R738	Same as R157				
	R739	Same as R163				
	R740	Same as R171				
	R41	Same as R172				
	R742	Same as R171				
	R743	Same as R329				
	R744	Same as R329				
	R745	Same as R171				
	R746	Same as R184				
	R747	Same as R184				
	R748	Same as R182				
	R749	Same as R182				
	R750	Same as R195				
	R751	Same as R195				
	R752	Same as R104				
	R753	RESISTOR, MF 1 k 1%, 1/8W	19701	MF5C-D-1001-F	102097	4
	R754	Same as R753				
	R755	Same as R26				
	R756	Same as R753				
	R757	Same as R753				
	R758	Same as R104				
	R759	Same as R173				
	R760	Same as R8				
	R761	Same as R301				
	R762	Same as R8				
	R763	Same as R124				
	R764	Same as R8				
	R765	Same as R10				
	R766	Same as R206				
	R767	Same as R12				
	R768	Same as R8				

TITLE PC BOARD ASSEMBLY #37000-928 (Cont'd)

ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	R769	Same as R177				
	R770	Same as R177				
	R771	Same as R209				
	R772	Same as R8				
	R773	Same as R219				
	R774	Same as R14				
	R775	Same as R114				
	R776	Same as R6				
	R777	Same as R31				
	R778	Same as R26				
	R779	Same as R193				
	Z1 thru Z4	INTEGRATED CIRCUIT Operational Amplifier	07263	μA741C	106621	13
	Z101	INTEGRATED CIRCUIT, LIN MSC Differential Voltage Comparator	07263	μ710C	106622	4
	Z102	INTEGRATED CIRCUIT, TTL SSI Quad 2-Input NAND Gate	04713	74H00N	025766	2
	Z103 thru Z106	Same as Z1				
	Z107	INTEGRATED CIRCUIT, TTL SSI Dual 2-Wide AND/OR Inverter Gate	04713	74H50N	025768	1
	Z108	INTEGRATED CIRCUIT, Array 5V	02735	CA3039	106623	1
	Z109	Same as Z101				
	Z110	Same as Z1				
	Z111	Same as Z1				
	Z301	Same as Z1				
	Z302	Same as Z1				
	Z303	Assembly				
	Z304	INTEGRATED CIRCUIT, LIN MSC 3 Transistor + Differential Power	02735	CA3046	025725	2
	Z401	INTEGRATED CIRCUIT, LIN MSC 4-Quad Multiplier	04713	MC1495	106624	1
	Z402	Same as Z304				
	Z701	Same as Z101				
	Z702	Same as Z102				

TITLE		PC BOARD ASSEMBLY #37000-928 (Cont'd)				
ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	Z703	Same as Z101				
Z70	Z704	Same as Z1				
948		SCREW, PHMS 4-40 x 3/8	96906	MS51957-15	10062606	5
949		SCREW, FHMS 4-40 x 3/8	96906	Ms24693-C4	10072006	3
950		WASHER, Flat #4	96906	NAS620-42	100683	20
951		NUT, Kep	78189	511-041800-00	100941	12
952		WASHER, Shoulder #4	16758	727477	112580	12
953		WASHER, Mica Round	86928	5624-37-5	112371	24
954		SCREW, PHMS 4-40 x 7/16	96906	MS51957-16	1006267	13
955		SCREW, FHMS 4-40 x 7/16	95987	N-440-7/16 BHBLK	116991	1
956		CLAMP, Cable	59730	TC-104	112574	3
957		BEAD, Glass			102839	A/R
958		TERMINAL, Swage	88245	1309B-1	100508	12
959		BRACKET, Right Hand	52542	32001136	32001136	1
		BRACKET, Left Hand	52542	32001458	32001458	1
		BRACKET, Side to Side	52542	32001153	32001153	1
		INSULATOR	52542	075662	075662	1
		PAD, Transistor			112276	21
		PAD, Transistor	07047	10243 XTM005	112280	60

CHAPTER 7

DRAWINGS

7.1 INTRODUCTION

This chapter contains final assembly and schematic drawings for the Model 410 Sweep Function Generator. The schematic diagrams relate to the detailed circuit descriptions located in Chapter 4 of this manual. The parts list contained in Chapter 6 relate to the reference designation callouts on the diagrams. Table 7-1 provides a list by figure number of the drawings, with title, drawing number and manual page number.

TABLE 7-1 LIST OF DRAWINGS

Figure Number	Drawing Title	Drawing Number	Page Number
7-1	Functional Block Diagram	41000-226	7-3
7-2	Block Diagram	41000-224	7-4
7-3	PC Board Assembly	37000-928	7-5
7-4	Main Generator Schematic (Sheet 1 of 2)	40000-402	7-6
7-5	Main Generator Schematic (Sheet 2 of 2)	40000-402	7-7
7-6	Sweep Generator Schematic (Sheet 1 of 2)	40000-403	7-8
7-7	Sweep Generator Schematic (Sheet 2 of 2)	40000-403	7-9
7-8	Output Amplifier Channel A/B Schematic	40000-406	7-10
7-9	Sine Converter Schematic	40000-404	7-11
7-10	Amplitude Modulation Schematic	40000-405	7-12
7-11	Power Supply Schematic	40000-401	7-13
7-12	Front Panel Schematic (Sheet 1 of 2)	40000-407	7-14
7-13	Front Panel Schematic (Sheet 2 of 2)	40000-407	7-15

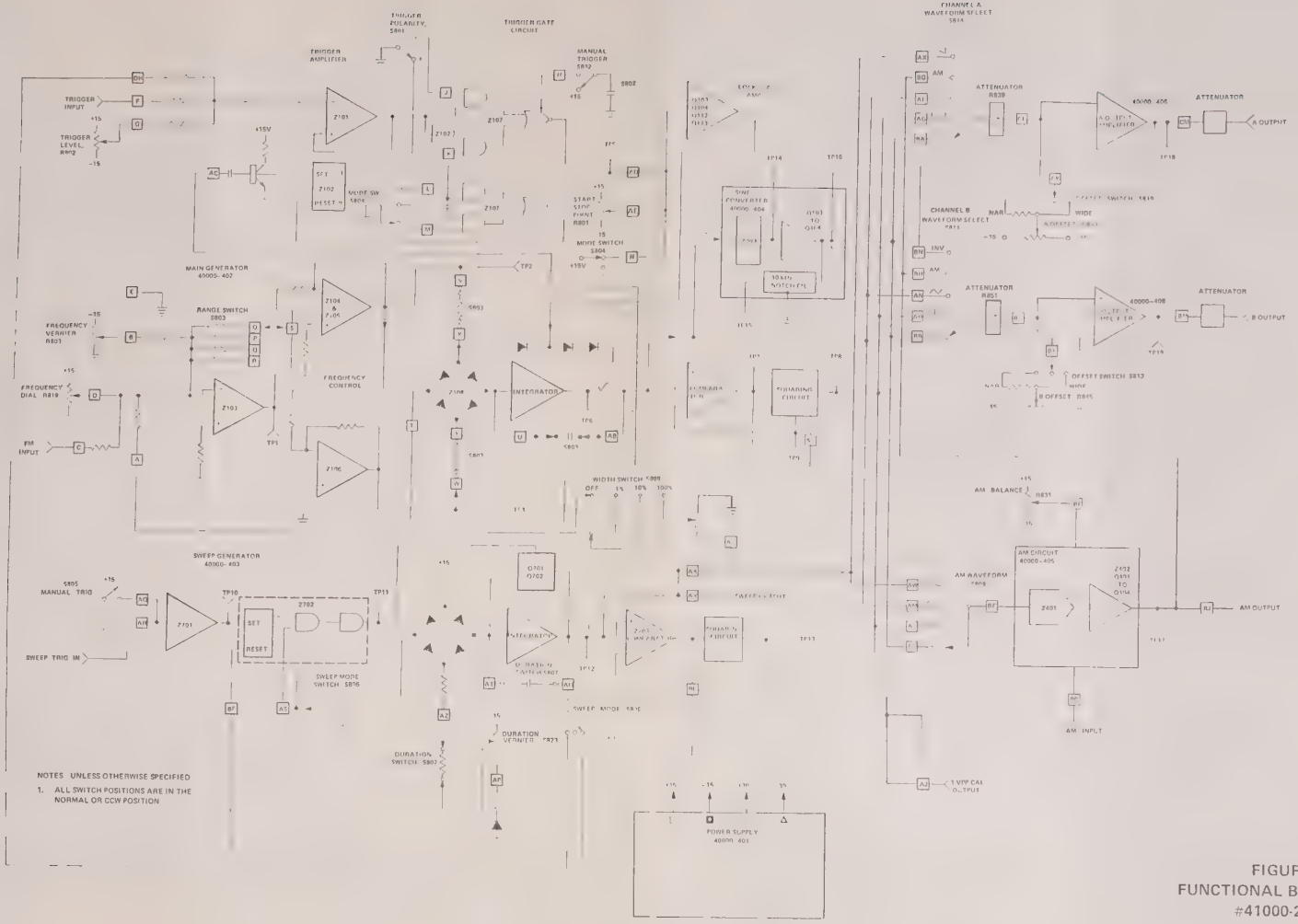


FIGURE 7-1
FUNCTIONAL BLOCK DIAGRAM
#41000-226 Rev A

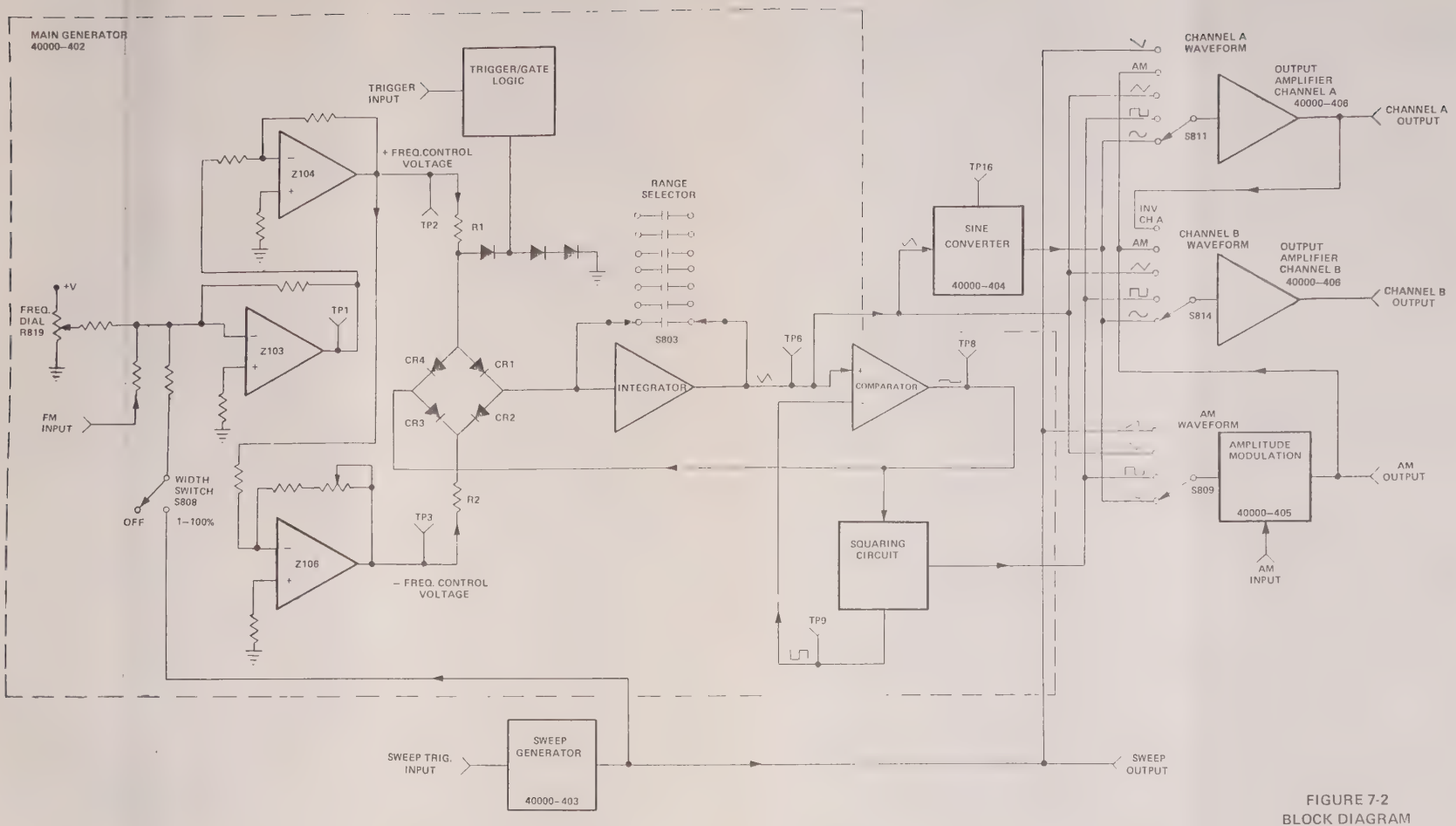


FIGURE 7-2
BLOCK DIAGRAM
#41000-224 Rev A

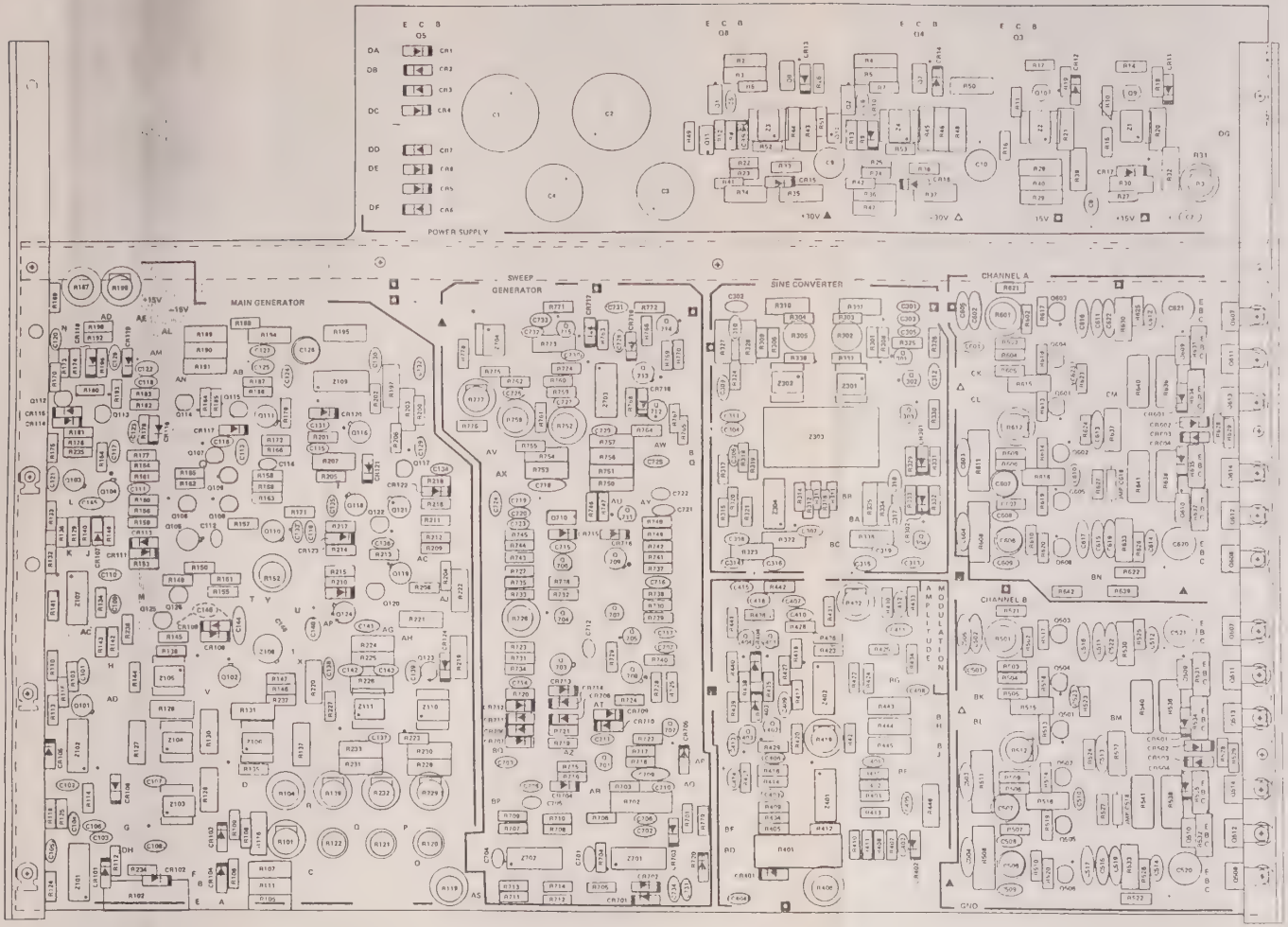


FIGURE 7-3
PC BOARD ASSEMBLY
#37000-928

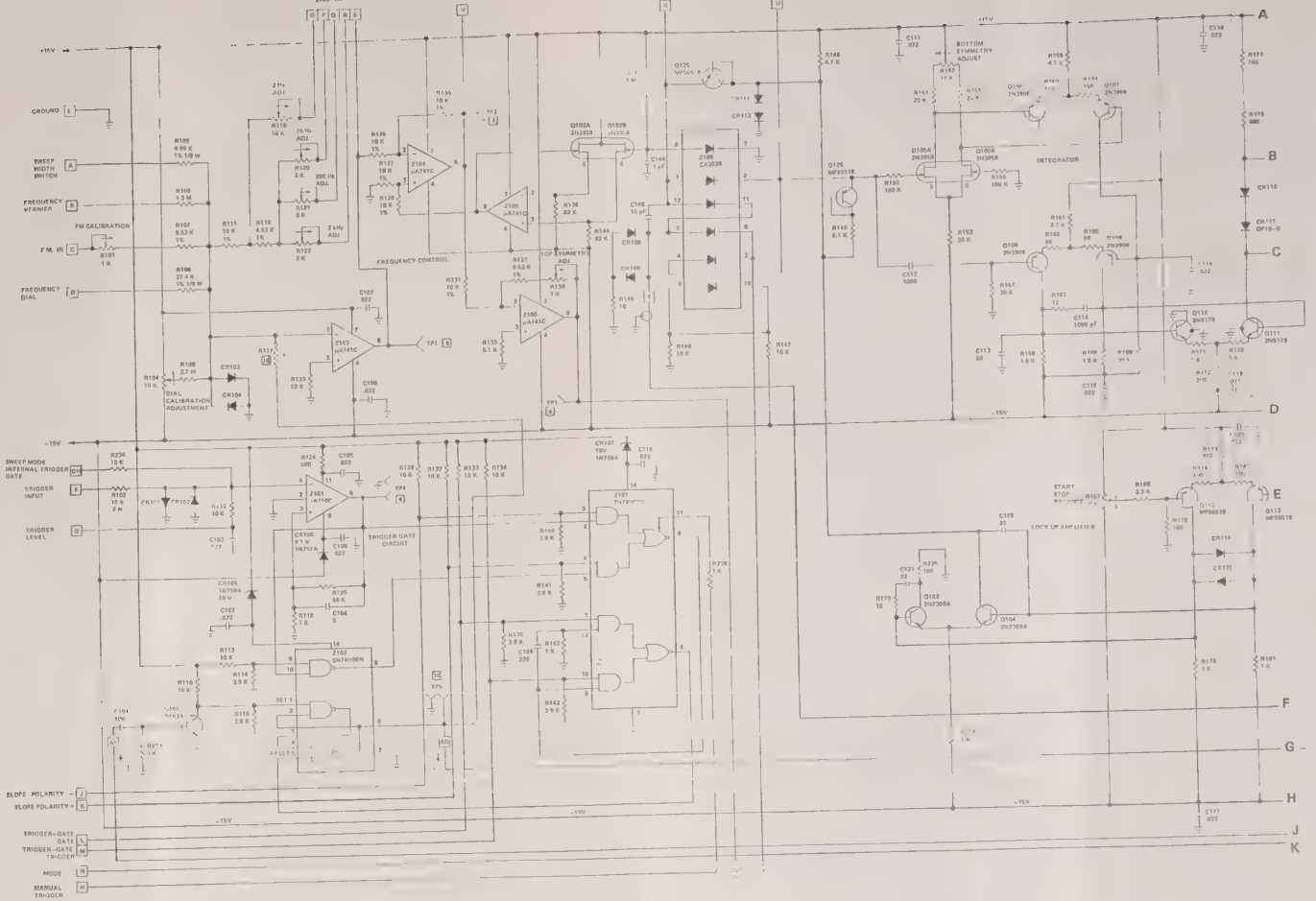
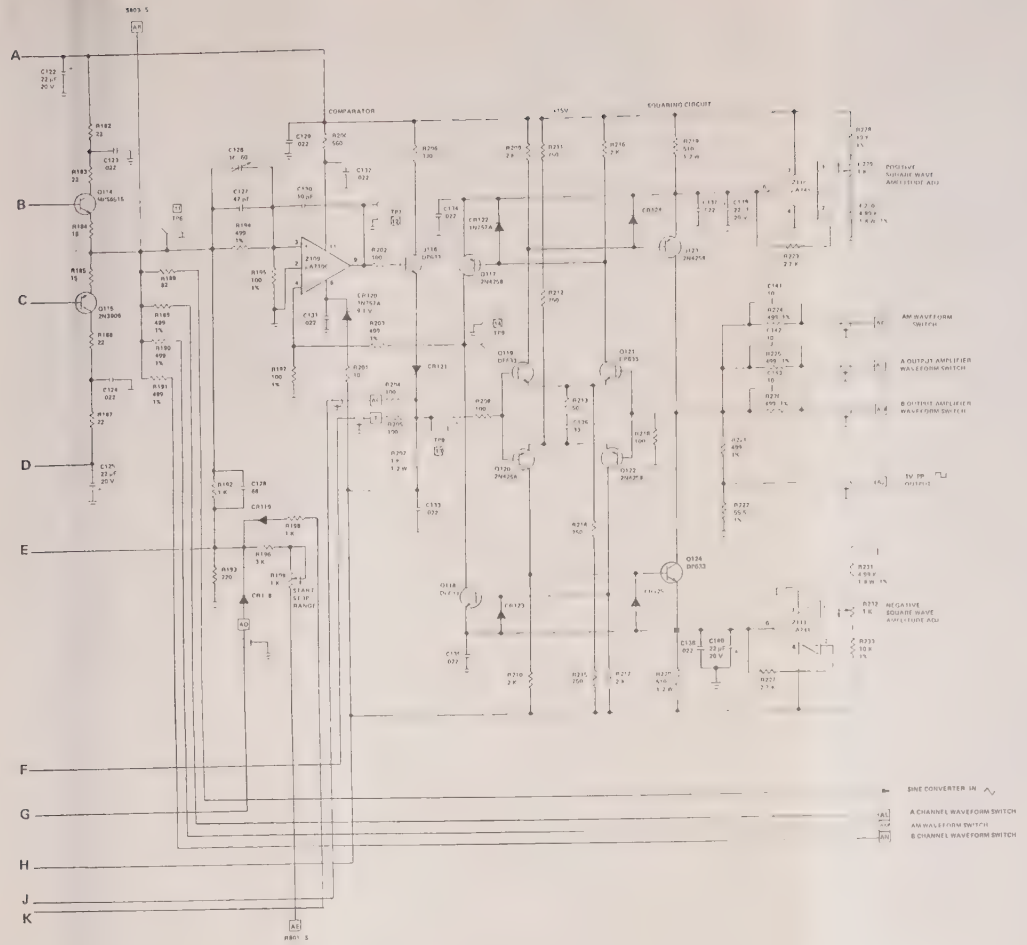


FIGURE 7-4
MAIN GENERATOR SCHEMATIC
#40000-402 Rev H (Sheet 1 of 2)

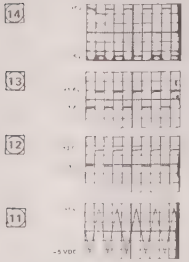
410-9-81



17. All diodes are DP16 - 0 / IN3600

16. * R117 is not installed. For phase lock capabilities add a 1 MΩ resistor between these points.

15. All test point readings are for test purposes only and are approximate.



10. TP5 - Main generator locked up +3.3V. Main generator free run, trig. input with trig. polarity sw. in + position +.0V trigger level centered.

9. TP4 - Main generator locked up +3.3V. Main generator free run, trig. input with trig. polarity sw. in + position +.0V trigger level centered.

8. TP3 - Dial at 1, range Z1: -5.8 VDC

7. TP2 - Dial at 1, range X1 thru X1M: +5.8 VDC

6. TP1 - Dial at 1, range X1 thru X1M: -5.1 VDC

5. Test point readings are taken with the frequency vernier in the CAL position.

4. Boxed letters indicate specific labeled points on CKT. bd.

3. All capacitor values greater than one are in pF.

2. All capacitor values less than one are in μF.

1. All resistor values are in ohms, 1/4 W, 5%.

NOTES: Unless otherwise specified.

FIGURE 7 - 5
MAIN GENERATOR SCHEMATIC
#40000-402 Rev H (Sheet 2 of 2)

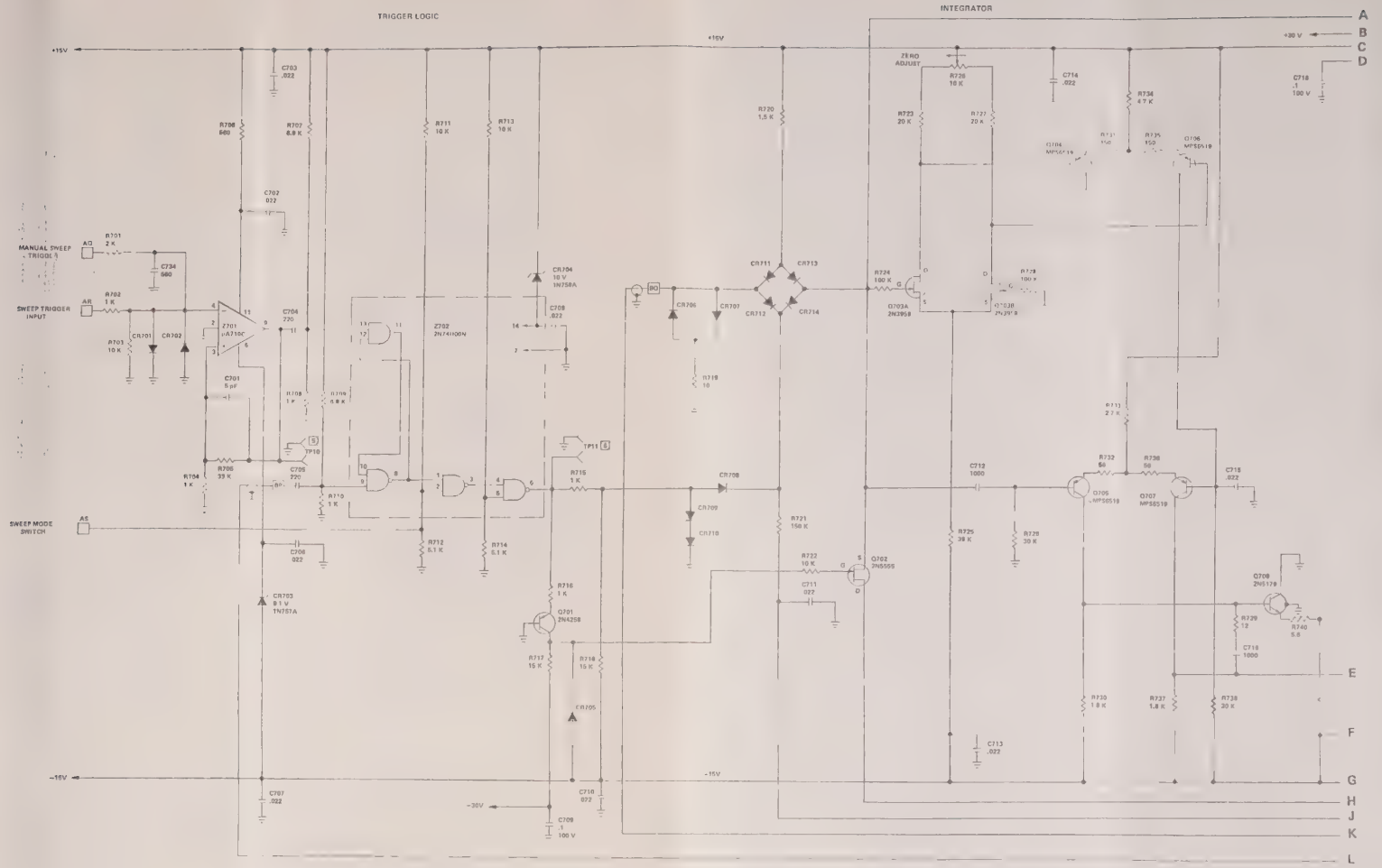
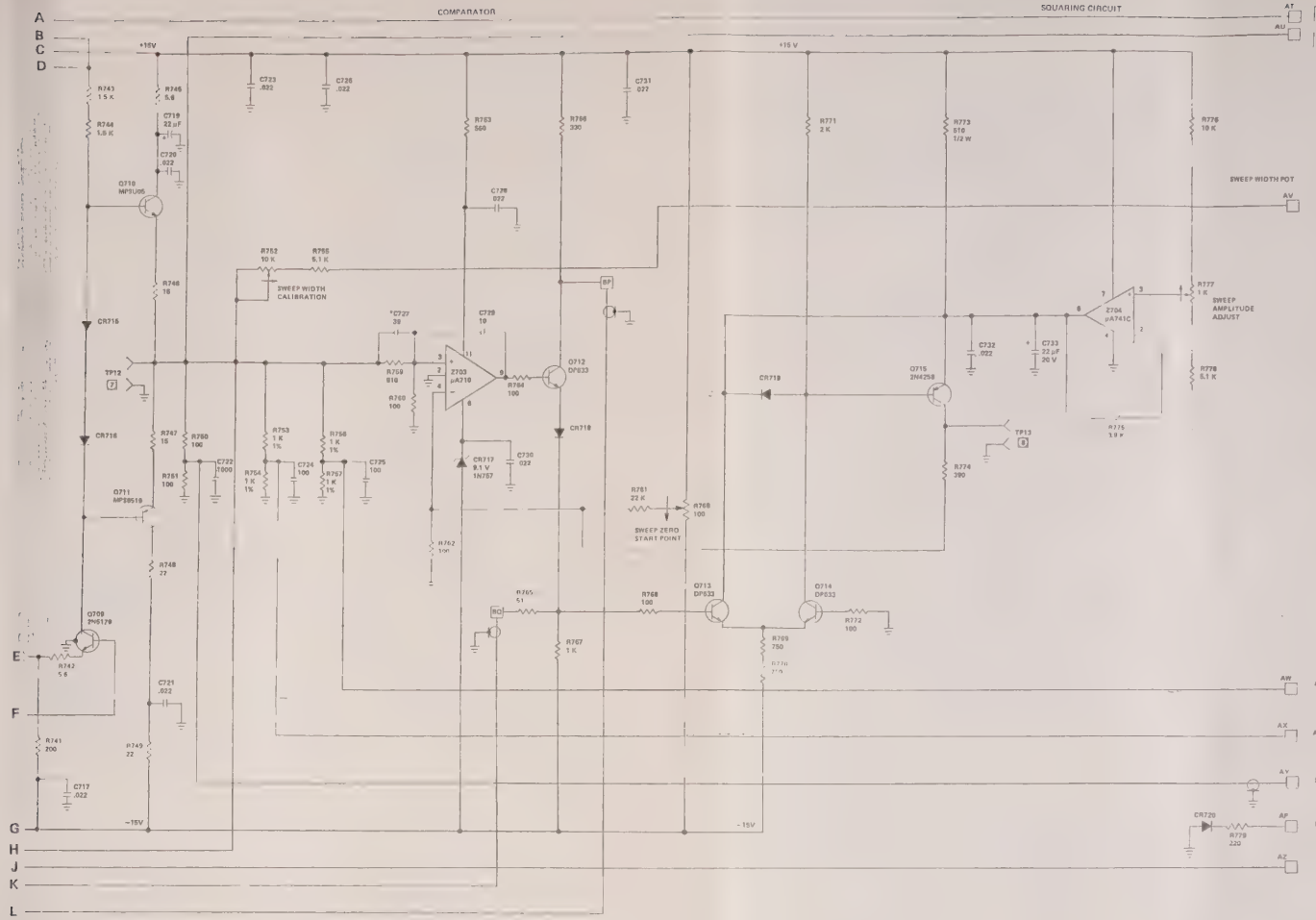
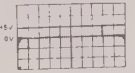


FIGURE 7-6
SWEEP GENERATOR SCHEMATIC
#40000-403 Rev C (Sheet 1 of 2)

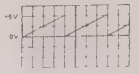


11. * Indicates factory adjust.
10. All test point readings are for test purposes only and are approximate.
9. All capacitor values less than one are in μF.

8



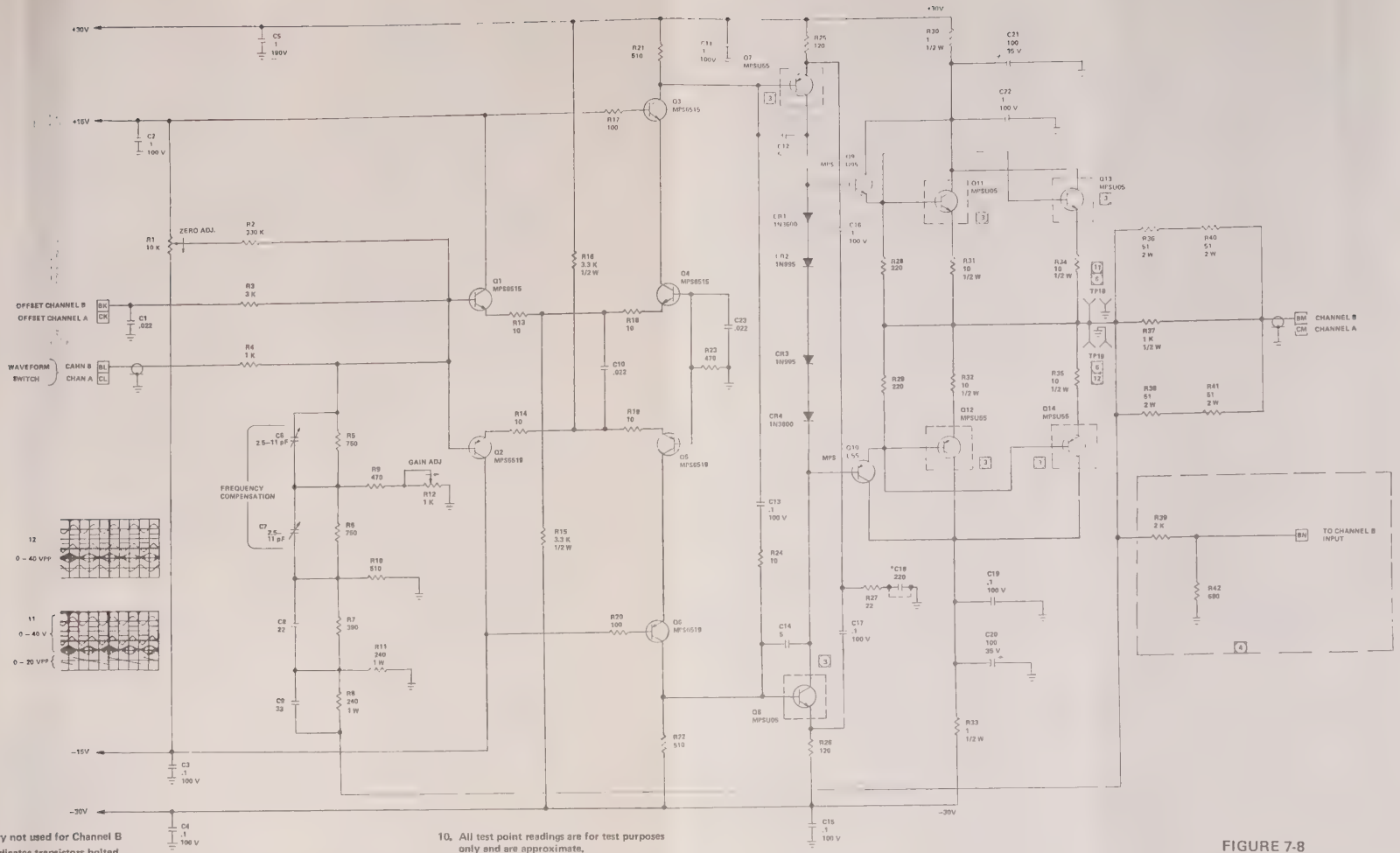
7



6. Sweep Generator: Triggered -.0 VDC
   Locked up +3 VDC
5. Sweep Generator: Triggered -.0 VDC
   Locked up + VDC
4. Test point readings are taken with the frequency vernier in the CAL position.
3. All resistors are in ohms, 1/4 W, 5%.
2. All diodes are DP 16 - 0/ IN3600.
1. All capacitor values greater than one are in pF.

NOTES: Unless otherwise specified.

FIGURE 7-7
SWEEP GENERATOR SCHEMATIC
#40000-403 Rev C (Sheet 2 of 2)



4. This circuitry not used for Channel B
3. Q7 - Q12 indicates transistors bolted to siderail.
2. All capacitor values greater than one are in PF.
1. All resistor values are in ohms, 1/4 W, 5%.

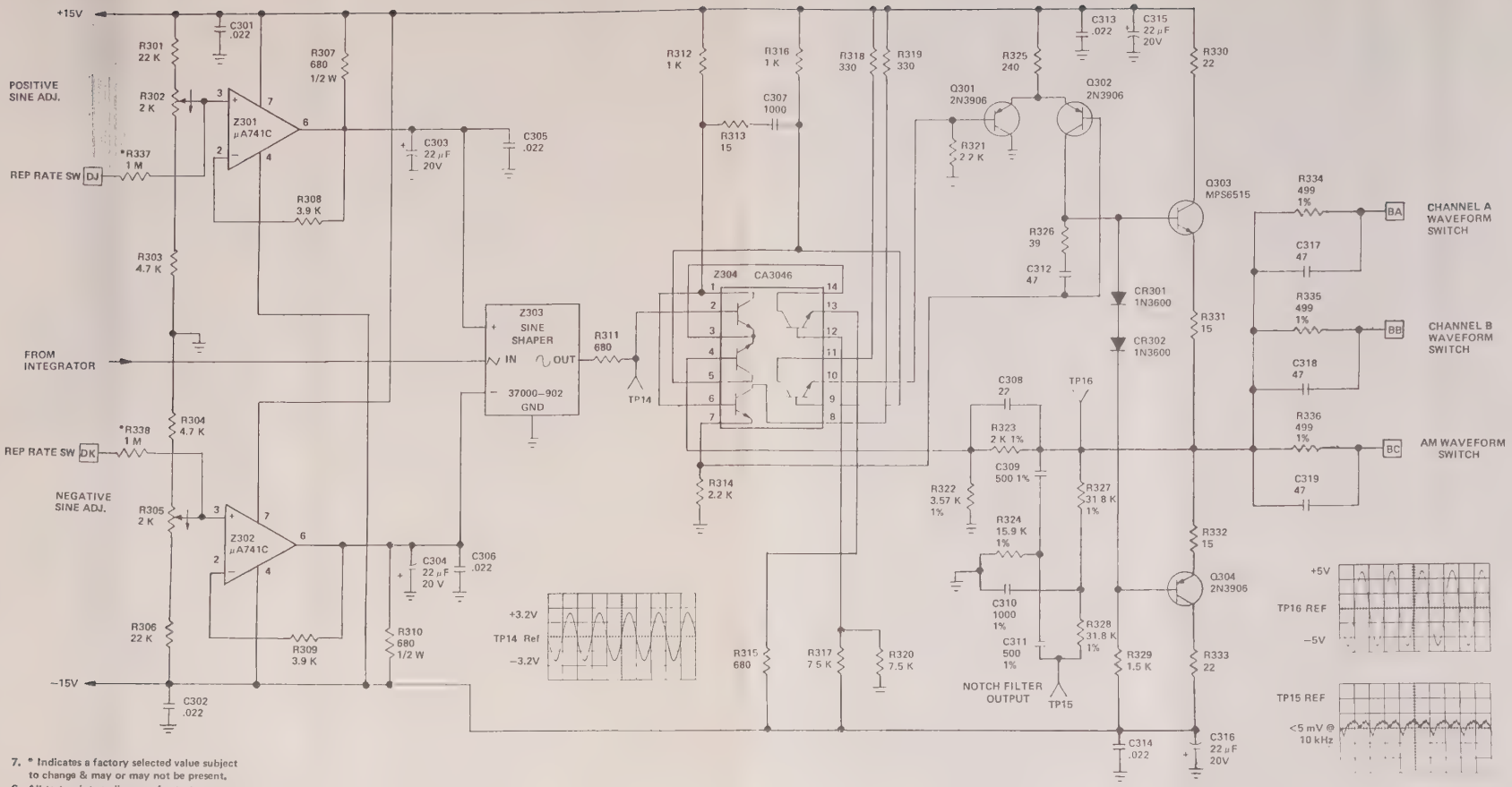
NOTES: Unless otherwise specified.

5. Prefix Ref. Desig. with 600 for Channel A CKT. & 500 for Channel B Ckt.

IE: R 501 etc. is Channel; A; R 601 etc. is Channel B.

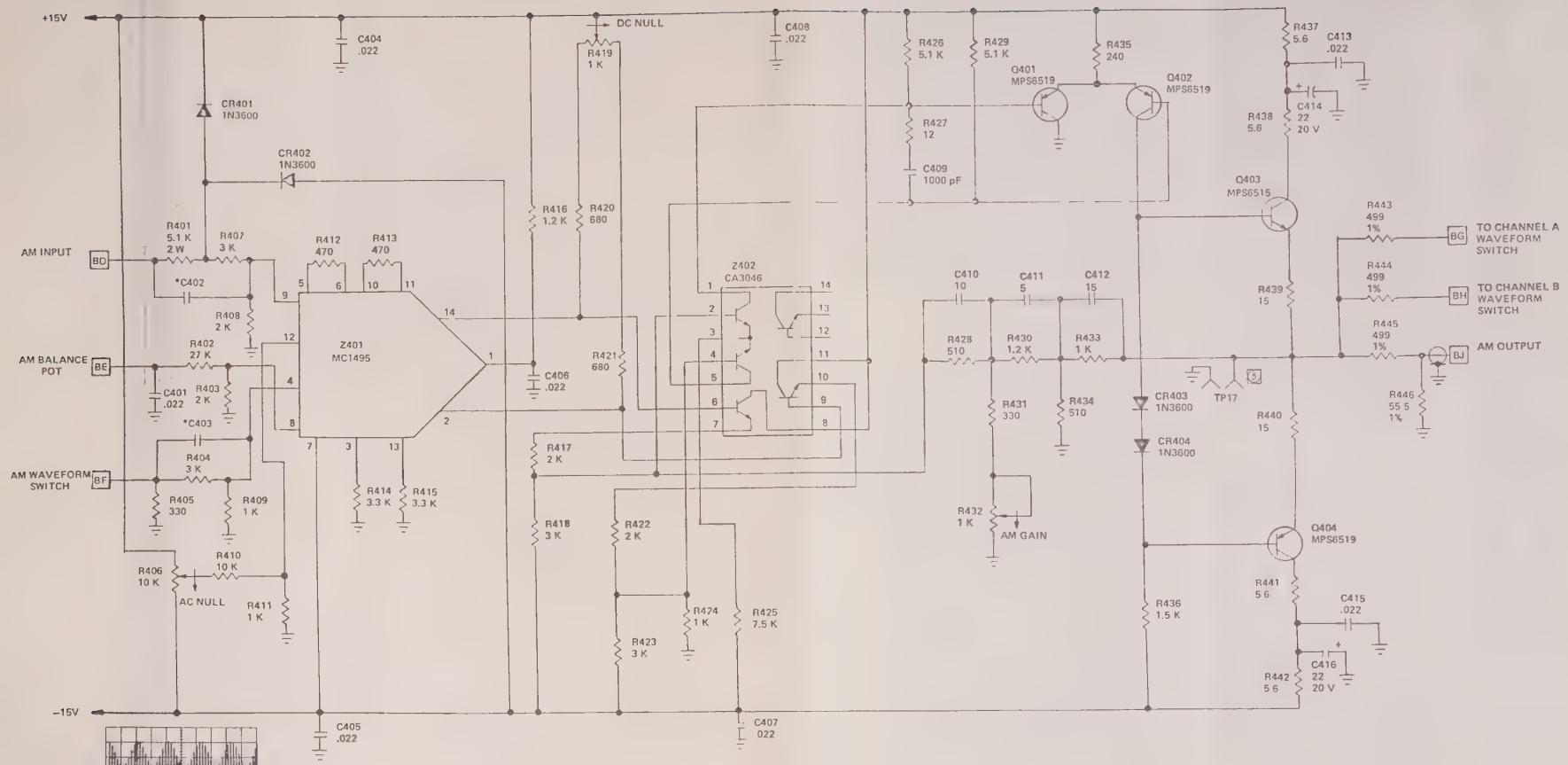
10. All test point readings are for test purposes only and are approximate.
9. All capacitor values less than one are in μF
8. Test point readings are taken with the frequency vernier in the CAL position.
7. *Indicates factory adjust, may or may not be present, jumper if not used
6. TP 18 indicates test point for Channel A & TP 19 for Channel B.

FIGURE 7-8
OUTPUT AMPLIFIER CHANNEL A/B
SCHEMATIC #40000-406 Rev B



7. * Indicates a factory selected value subject to change & may or may not be present.
6. All test point readings are for test purposes only and are approximate.
5. All capacitor values less than one are in μF.
4. Test point readings are taken with the frequency vernier in the CAL position.
3. Boxed letters indicate specific labeled points on CKT. bd.
2. All capacitor values greater than one are in pF.
1. All resistor values are in ohms 1/4 W, 5%.

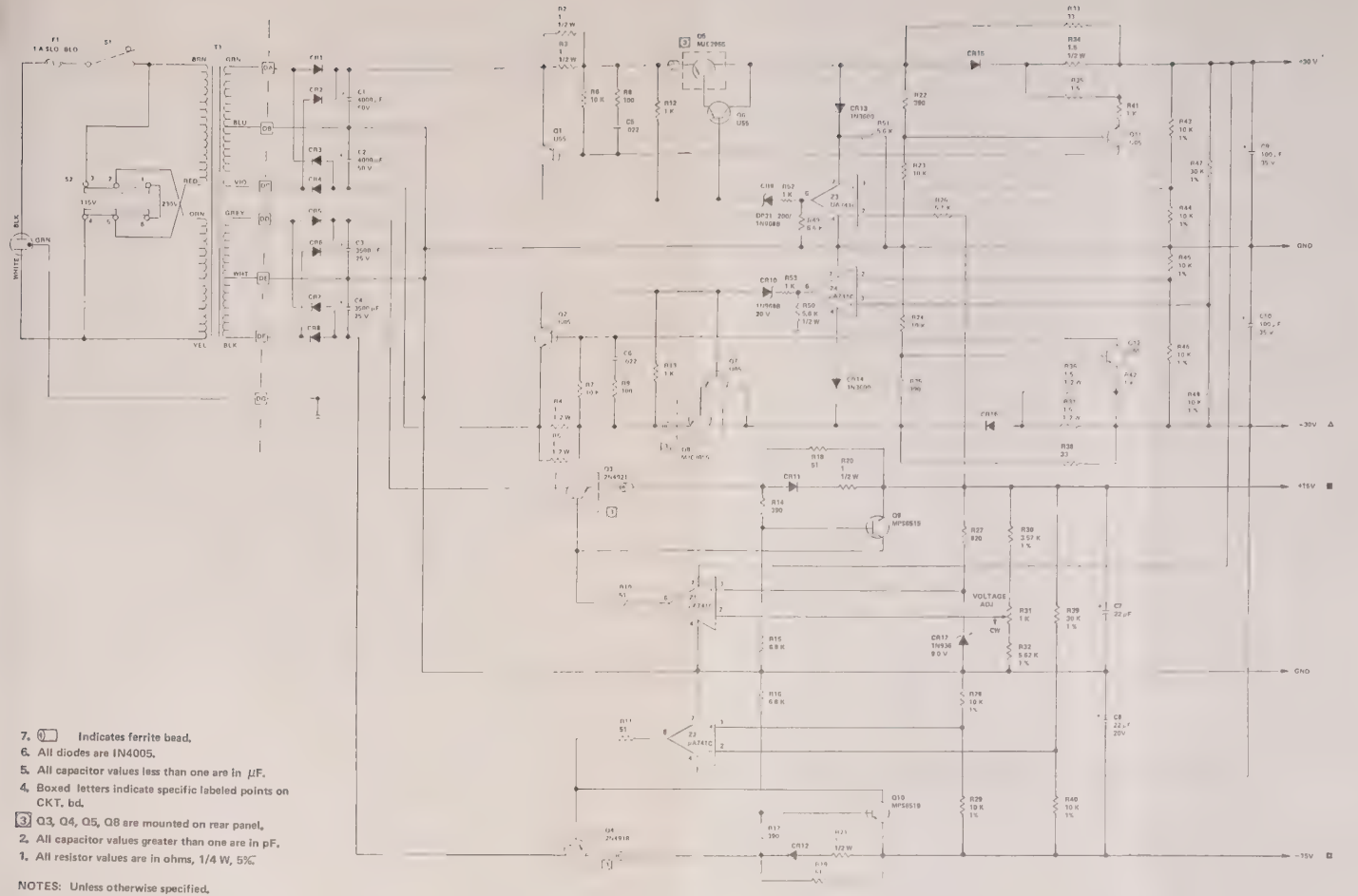
FIGURE 7-9
SINE CONVERTER SCHEMATIC
#40000-404 Rev F



4. * Indicates factory adjust, may or may not be present.
3. Boxed letters indicate specific labeled points on CKT. bd.
2. All capacitor values greater than one are in pF.
1. All resistor values are in ohms, 1/4 W, 5%.

8. Test point readings are taken with the frequency vernier in the CAL position.
7. All capacitor values less than one are in μF.
6. All test point readings are for test purposes only and are approximate.

FIGURE 7-10
AMPLITUDE MODULATION SCHEMATIC
#40000-405 Rev A



7. ⓪ Indicates ferrite bead.
6. All diodes are IN4005.
5. All capacitor values less than one are in μF.
4. Boxed letters indicate specific labeled points on CKT. bd.
3. Q3, Q4, Q5, Q8 are mounted on rear panel.
2. All capacitor values greater than one are in pF.
1. All resistor values are in ohms, 1/4 W, 5%.

NOTES: Unless otherwise specified.

FIGURE 7-11
POWER SUPPLY SCHEMATIC
#40000-401 Rev E

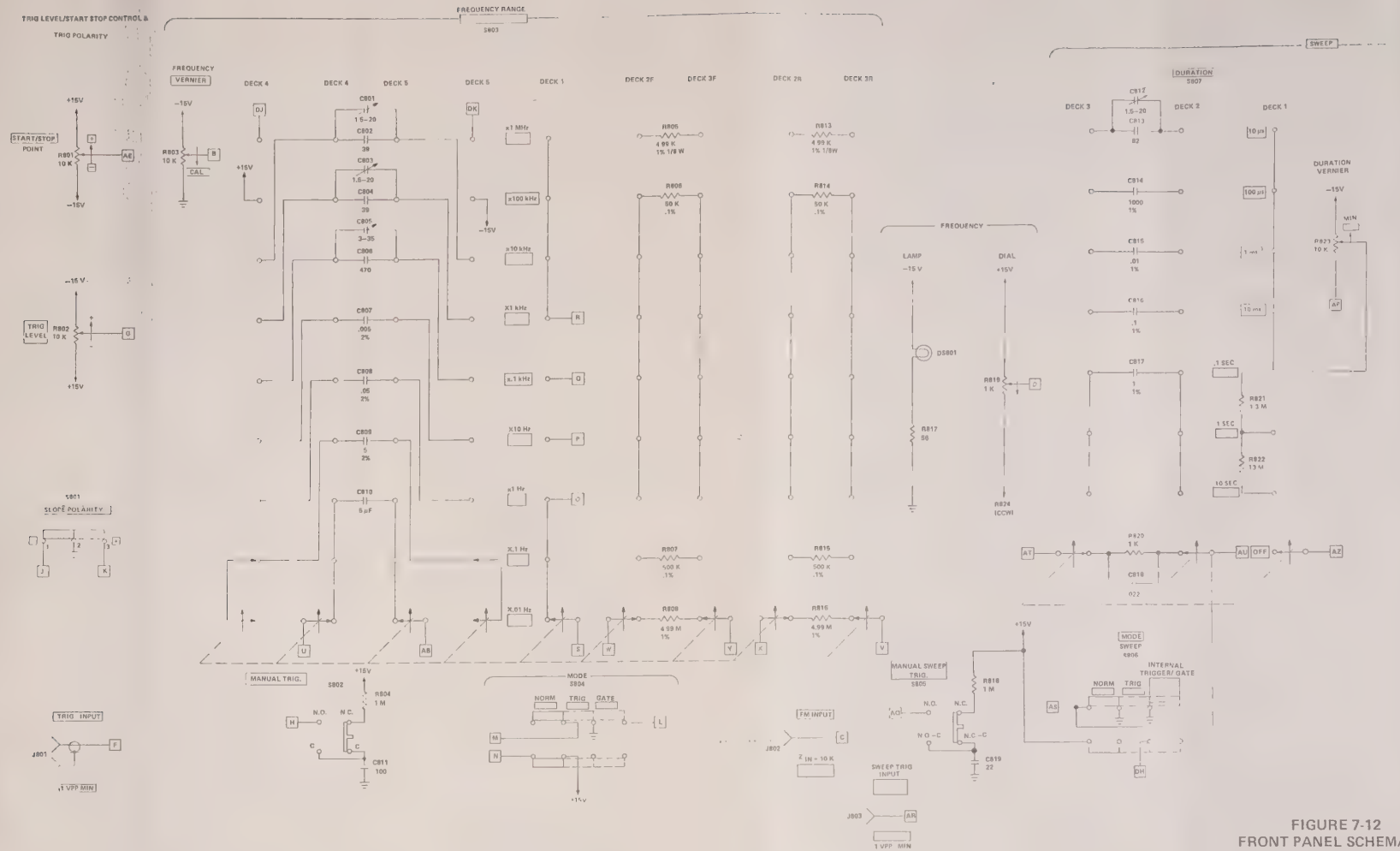
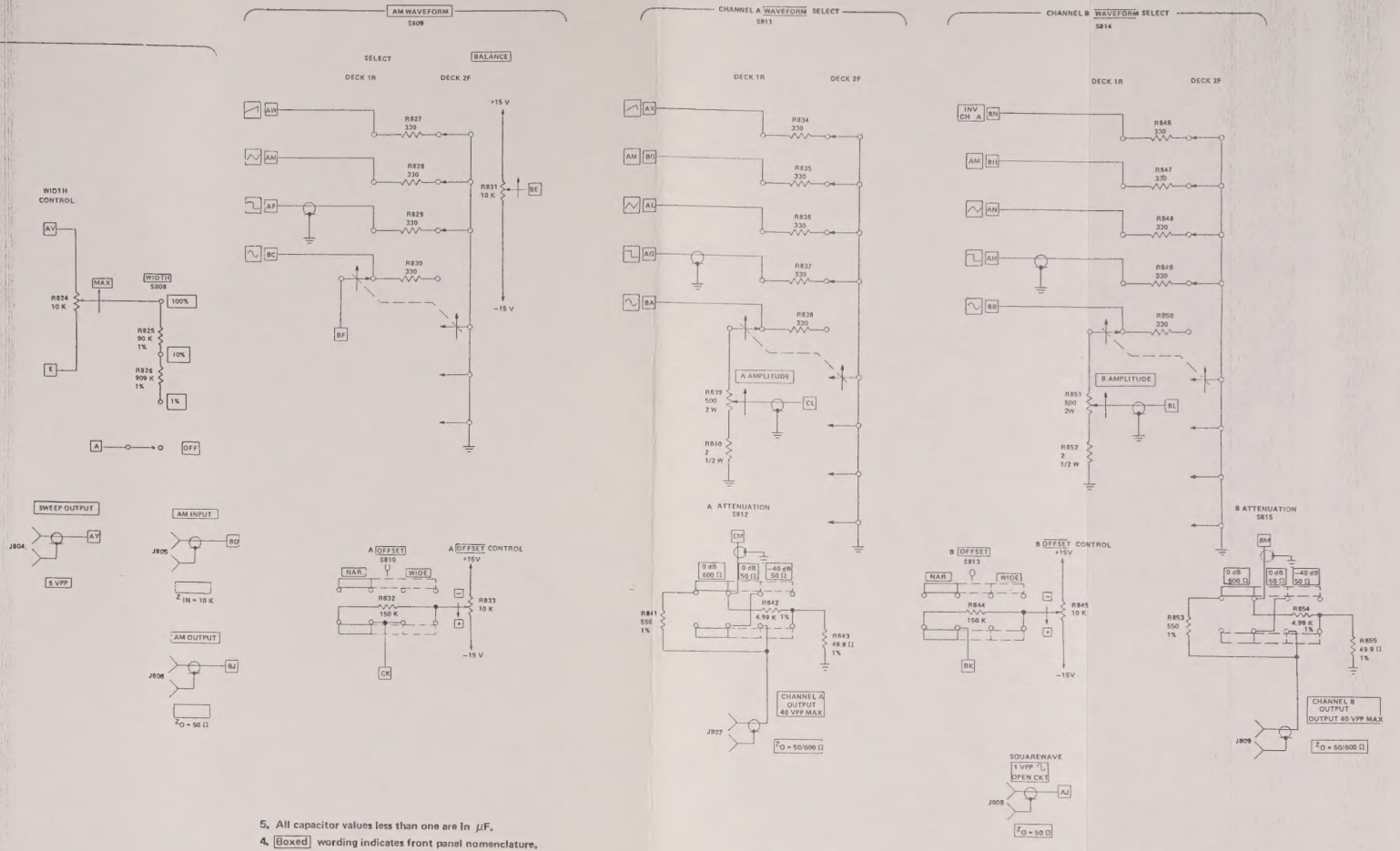


FIGURE 7-12
FRONT PANEL SCHEMATIC
#40000-407 Rev F (Sheet 1 of 2)



5. All capacitor values less than one are in μF.
4. Boxed wording indicates front panel nomenclature.
3. Boxed letters indicate specific labeled points on CKT. bd.
2. All capacitor values greater than one are in pF.
1. All resistor values are in ohms, 1/4 W, 5%.

NOTES: Unless otherwise specified.

FIGURE 7-13
FRONT PANEL SCHEMATIC
#40000-407 Rev F (Sheet 2 of 2)

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